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CONTENTS

Cover Picture: Missionaries travelling on Great Slave Lake, from a drawing by Emile Petitot, January 1863.

Fig. 1. Looking southeast across Caledonian Bay, east coast of Canyon Fiord. The peaks in the background consist of dark limestone, presumably corresponding to the Offley Island formation of Middle Silurian (Late Llandovery; Clinton) age. To the left of the peak in the centre may be seen a gap in the ridge. This gap indicates the position of steeply dipping graptolite shales (visible in Fig. 6 as a dark band) which may belong to the Cape Tyson formation of Late Silurian (Tarannon–Wenlock) age. The low hills near the coast consist of sandstones and shales, which provisionally are referred to the Polaris Harbour formation of doubtful Late Silurian (Ludlow) age. The "shoulder" or plateau remnant between the high peaks and the coast is clearly seen. The arrow indicates the locality shown in Fig. 7. May 1952.

GEOLOGICAL INVESTIGATIONS IN ELLESMERE ISLAND, 1952

J. C. Troelsen*

DR. LAUGE KOCH's ideas on the age of the folded mountain system in north Greenland and Ellesmere Island have for the last thirty years been a storm centre in Scandinavian geology. It has been maintained by several geologists that Koch's theory of a Caledonian age of the folding was not supported by acceptable evidence, and as late as 1950 Hans Frebold (1951, p. 42) stated that: "Das Alter der Nordgrönland–Grinnell-Land-Faltenzone ist noch ungeklärt und neuerdings bekanntgewordene Tatsachen sprechen für das Vorliegen jüngerer Faltungen in diesem Raume" ("The age of the north Greenland-Grinnell Land zone of folding is not yet known, and recently published evidence suggests the presence of younger foldings within this area").

On the Danish Thule–Ellesmere Land Expedition in the spring of 1940 I attempted unsuccessfully to solve the problem of the age of the mountain system in Ellesmere Island, though clear evidence was found of a gentle post-Triassic folding. Circumstantial evidence derived from the literature and from my field observations suggested, however, that the main folding of the mountain system took place some time between the Silurian and the Middle Carboniferous periods, possibly in Late Silurian and/or Middle to Late Devonian time (Troelsen, 1950a).

Later, as a member of the Danish Pearyland Expedition, I was able to prove that a folding had taken place between Middle Ordovician (Silurian fossils were found in the unfolded sequence but not within the belt of folding) and Late Carboniferous times in the north Greenland end of the mountain system (Troelsen, 1950b). In Peary Land there is thus a considerable time gap between the folded and the overlying unfolded rocks and, as the sequence of geological events has not necessarily been the same throughout the north Greenland–Ellesmere Island mountain system, further research in Ellesmere Island was needed.

In 1940 I formed the impression that the key to the problem should be sought somewhere near Canyon Fiord, west Ellesmere Island, but I was unable to spend much time looking for it. When I heard that a weather station had been built in 1947 at Slidre Fiord, not far from Canyon Fiord, I decided to make another attempt at the mountain folding in Ellesmere Island, but it was not until March 1952 that I was ready to leave for the Arctic.

The 1952 expedition was made possible in part by a grant from the Arctic Institute of North America, with funds provided by the U.S. Government. When it became apparent that the budget as originally planned was insufficient, the University of Copenhagen and the Danish Rask-Ørsted Foundation made

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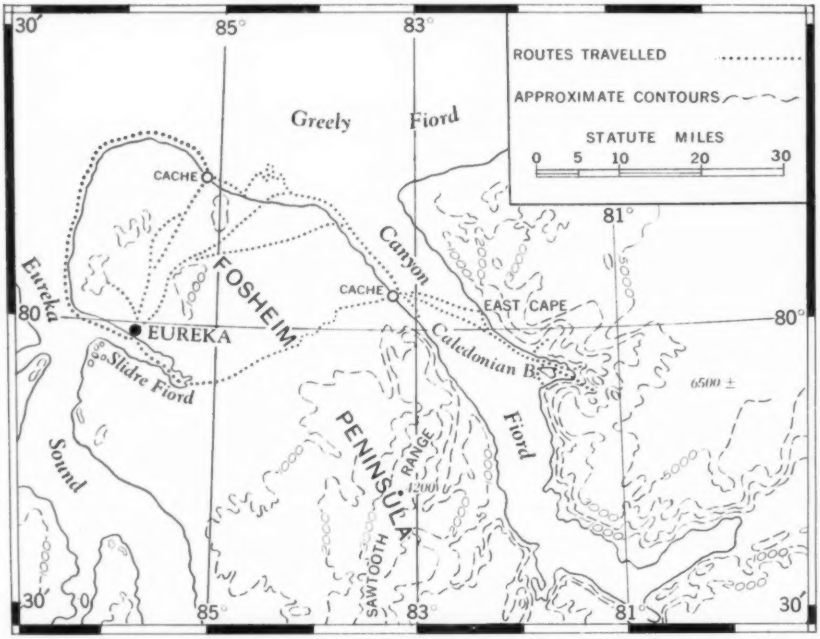

Fig. 2. Sketch-map of west central Ellesmere Island, based on World Aeronautical Chart No. 20, published June 1951.

additional grants. The Defence Research Board in Ottawa lent a set of R.C.A.F. photographs of the Canyon Fiord region and, together with the Arctic Institute, assisted me in planning details of the expedition. Permission to use the Eureka weather station as a base was granted by the Controller of the Meteorological Division, Canadian Department of Transport. Transportation from Montreal to the Arctic and back was provided by the R.C.A.F., the U.S.A.F., and the U.S. Navy. I am indebted to all these institutions and agencies and to many individuals for help and advice.

Field work

Previous expeditions to the Canyon Fiord region: the Second Norwegian Polar Expedition in the *Fram*, 1898–1902; the Macmillan Crocker Land Expedition, 1913–7; and the Danish Thule–Ellesmere Land Expedition, 1939–41, had travelled with sledges pulled by large dog teams. Because of the expense and difficulties involved in securing and transporting a complete dog team and their food to Ellesmere Island, I had planned to use a light Swedish *pulka* drawn by one or two dogs. Unfortunately, on my arrival in northwest Greenland in April 1952 I found that an outbreak of dog disease made it impossible to obtain any dogs there, and an offer to lend me some from the Eureka weather station had to be declined as they were not trained for

Fig. 3. The second start from Eureka weather station. May 1952.

sledging. For reasons beyond the control of the weather station no mechanical transportation was available at the time. As it was now too late to abandon or postpone the expedition, I therefore decided to pull the *pulka* myself.

On April 19 I arrived by air at Eureka weather station, on the north coast of Slidre Fiord, and set out the following day for Canyon Fiord. The route lay through Slidre Fiord and across the low plain northwest of Sawtooth Range.[1] As the load was very heavy, relaying had to be resorted to, and it soon became apparent that the most advantageous course would be to cache as much food and kerosene as possible on the west coast of Canyon Fiord and then to return to the weather station for additional supplies. On May 1 I was back at the base, and left again for Canyon Fiord on May 4. As the going on the plain and along the river beds was already deteriorating because of evaporation of the snow on the gravel banks, I decided to travel on the sea ice north around Fosheim Peninsula. It took five days to reach the cache in Canyon Fiord and another two days to Caledonian Bay[2] on the east coast of the fiord.

A careful study of stereoscopic pairs of air photographs had indicated that two areas were of special interest: at Caledonian Bay and to the southwest of

[1]This is the name in local use. It has not as yet been adopted by the Canadian Board on Geographical Names.

[2]This name has not as yet been adopted by the Canadian Board on Geographical Names.

the head of Canyon Fiord.[1] As it turned out, it was most fortunate that the first area held the answers to most of the problems with which I was concerned.

Special permission had been obtained to shoot a small number of Arctic hares,[2] as I had been asked to make a collection for a Danish zoologist. Naturally I wanted to kill the hares at a time and place where their meat would be of most use, so I had planned to take them on the east coast of Canyon Fiord. Although former travellers had found Canyon Fiord to be teeming with Arctic hares, I did not see a single one, and during my stay here I subsisted on hardtack and dried codfish, supplemented by some military K-rations. By strict rationing the stay in Caledonian Bay was extended to ten days, during which time the more important problems concerning the mountain folding were solved. The plans for an examination of the southern part of Canyon Fiord could thus be abandoned without seriously affecting the scientific program.

The last bit of food was eaten before I revisited my cache (or what remained of it) on the west coast of the fiord. Within half an hour, five hares had been killed in a valley nearby and many more were seen. After collecting some Mesozoic and Permian fossils at a point a few miles south of the cache I started back towards the weather station with a full load of fossils and rock samples.

By the time I reached the mouth of Canyon Fiord, the only food left was some carcasses of Arctic hares. As it turned out to be a rather trying experience to do hard work on a straight diet of hare meat, I temporarily abandoned camp and sledge and walked overland to the weather station. The 33-mile trip seemed rather a long one, but on the morning of May 27 I reached my goal.

After a few days spent in resting and eating, I carried a food depot to the north coast of Fosheim Peninsula. Later, on June 7, with my rucksack once more filled with food, I walked overland to the campsite at the mouth of Canyon Fiord. The rivers in northeastern Fosheim Peninsula were now in flood. Some of the largest and swiftest streams had a coating of slippery ice on the bottom, while others flowed in beds of deep slush. In all, no less than thirty-six hours were spent in covering the distance of 35 miles.

On the sea ice the snow had now given way to shallow pools of meltwater, and leads were opening everywhere. The largest leads were at the mouths of the main rivers and could only be crossed after they had been followed seawards for several miles. In a number of places patches of hummocky ice, probably old floe ice, cut by a maze of deep channels and ponds, had to be crossed.

Gradually the bottom of the *pulka* wore out and, when the inside crosspieces began to drag on the ice, progress became nearly impossible. (In fairness to the manufacturer it should be mentioned that by far the greater part of this

[1]A plotting grid engraved on plexiglass was used for making rough estimates of distances and directions. The grid did not make any allowance for the variation of the angle of depression of individual photographs and, in this region, the relief of the mountainous areas was much too great for the proper application of the perspective grid method, but the grid was nevertheless useful for rapid work.

[2]Ellesmere Island is a game preserve.

Fig. 4. The sea ice to the north of Fosheim Peninsula in mid June. The north coast of Greely Fiord may be seen in the background.

Fig. 5. The bottom of the *pulka* after some 350 miles of sledging. June 1952.

Photo: R.C.A.F.

Fig. 6. Looking east across Caledonian Bay. The dotted line indicates the contact between the Middle Carboniferous in the foreground and the strongly folded Lower Paleozoic sediments. The Carboniferous rocks were disturbed by warping and weak folding in Late Mesozoic–Cenozoic time. The arrow indicates the locality shown in Fig. 7.

wear occurred during the last few days of travelling across rough, melting ice). Some 17 miles from the weather station I abandoned the sledge on the shore and walked back to the station, carrying only my notebooks, maps, and instruments. I was touched to find that the personnel at the base had left a food cache at the mouth of Slidre Fiord to lighten my return journey.

As my watch had stopped during a period of foggy and cloudy weather, I had lost track of time. On my return to the weather station I learned that I was two days overdue (it was now June 18) and that the R.C.A.F. had been requested to search for me. Fortunately we succeeded in contacting them before the search plane had taken off.

Towards the end of June the shore lead had opened so much that a canoe could reach the abandoned sledge. A wolf had torn a hole in the sledge cover and stolen the hare skulls, but all the other collections were brought back safely.

Fig. 7. In a valley running northwest to the head of Caledonian Bay. The steeply dipping graptolite shales in the foreground are believed to correspond to the Late Silurian (Tarannon–Wenlock) Cape Tyson formation. In the background there is a dip slope developed on the upper surface of a dark limestone, which presumably corresponds to the Middle Silurian (Late Llandovery; Clinton) Offley Island formation. May 1952.

The remainder of the summer was spent in the vicinity of the weather station, making geological, botanical, and zoological collections. On August 18 I left Eureka weather station.

Scientific results

Geology

The ridge immediately north of Caledonian Bay, on the east coast of Canyon Fiord, mainly consists of a large anticline, which is built up of unfossiliferous sandstones, slates, limestones, chert beds, and chert conglomerates. The age of this sequence is unknown but may conceivably be Late Precambrian.

South of Caledonian Bay there is a large syncline (Figs. 1 and 6), which seems to be separated from the large anticline by a major fault. The syncline is composed of fossiliferous limestones, shales, and sandstones (Fig. 7). On

the basis of lithological similarities and field identifications of fossils these beds have tentatively been assigned to the following formations, which are known from the unfolded sequence in north Greenland (Koch, 1929, pp. 238–42):

The Offley Island formation, of Middle Silurian (Late Llandovery; Clinton) age.

The Cape Tyson formation, of Late Silurian (Tarannon–Wenlock) age.

The Polaris Harbour formation, of doubtful Late Silurian (Ludlow) age.

Until the study of the collections has been completed this comparison cannot profitably be carried any further, but it is certain that Silurian fossils occur in the syncline.

Although the folding of the Lower Paleozoic strata around Caledonian Bay has been rather intensive, no metamorphic rocks above the rank of slate have been found. Neither were any intrusive rocks observed.[1] Similar conditions are known from northern Ellesmere Island (Troelsen, 1950a). There are therefore good reasons for classifying those parts of the folded mountains which have been examined as belonging to a miogeosyncline.

Around Caledonian Bay, Middle Carboniferous sandstones and limestones (with *Fusulina* and *Fusulinella*) are found resting upon (1) the folded unfossiliferous sedimentary strata north of the bay and (2) the folded Silurian sedimentary strata south of the bay (Figs. 1 and 8). The low island in the bay also consists of Carboniferous rocks. It was definitely proved that the contact between the Carboniferous and the older rocks is an irregular erosion surface overlain by a coarse conglomerate of water-worn pebbles.

[1]River gravels, moraines, and the Carboniferous basal conglomerate were also searched unsuccessfully for intrusives and highly metamorphosed rocks.

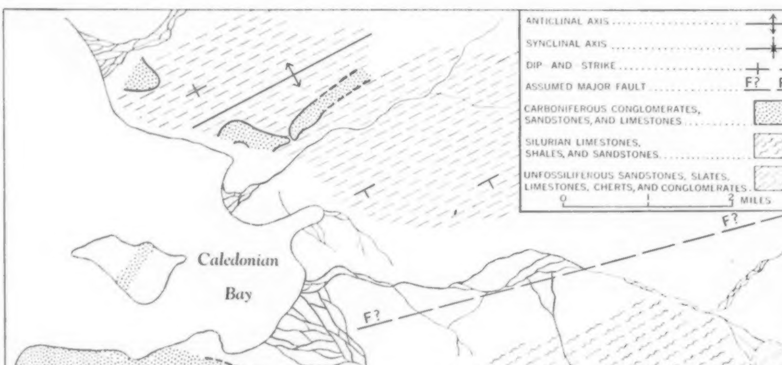

Fig. 8. Geological sketch-map of Caledonian Bay.

Fig. 9. Looking north towards East Cape. Dark Permian limestones (dipping away from the observer) have been thrust on top of light-coloured sandstones of Permian or Carboniferous age (dipping towards the observer). The thrusting is an effect of the Late Mesozoic or Cenozoic orogeny. May 1952.

The Carboniferous rocks truncate the older, folded rocks. At one place north of Caledonian Bay, a small erosional valley that parallels the trend of the old anticline was found to have been filled with Carboniferous sandstone. I got the impression that by Carboniferous time a bay already existed in the Caledonian Bay area (in this case, the assumed major fault was probably formed before Carboniferous time). The bay was filled with Carboniferous sediments, and later the whole structure was slightly warped. In comparatively recent geological time erosional forces have re-excavated the bay to form what is now Caledonian Bay and the large valley behind it. North of Caledonian Bay the erosion has been so thorough that only small patches of the Carboniferous strata have been left here and there on the hill sides.

For the first time in Ellesmere Island we thus have positive, irrefutable evidence of a post-Silurian (or possibly Late Silurian) but pre-Middle Carboniferous folding. This, together with what is now known about Peary Land (Troelsen, 1950b), proves the essential correctness of Lauge Koch's theory as to the age of the folding.

Fig. 10. Horizontal sandstone and clay with coal beds near the top of the cliff, central Fosheim Peninsula. These strata seem to have been deposited after the cessation of the Late Mesozoic-Cenozoic orogeny. April 1952.

The only Mesozoic deposit hitherto known with certainty from Ellesmere Island has been the Triassic Blaa (Blue) Mountain formation. This summer, at least one additional stratigraphic horizon was found in that region: on the plains around Slidre Fiord a sandstone bed, containing *Aucella* (=*Buchia*), is overlain by some 500 feet of soft shales, the lower part of which also contains *Aucella*, while higher in the shales there are (as yet unidentified) ammonites and belemnoids. The occurrence of *Aucella* proves the Late Jurassic–Early Cretaceous age of at least part of the sequence. Another belemnoid-carrying stratum was discovered in northeastern Fosheim Peninsula.

Parts of the skeleton of a large plesiosaurus (a marine reptile) were found in the shale formation about 2 miles from the weather station. Although the bones had been broken into innumerable fragments, it is hoped that it will be possible to reconstruct at least some of the limbs.

Our knowledge of the geological conditions in Ellesmere Island during the Middle Carboniferous, Permian, and Mesozoic times is too scattered and incomplete to permit any definite conclusions as to the extent and nature of

the basins in which the sedimentary rocks were deposited. It is certain, though, that these sedimentary rocks have been disturbed by a gentle folding (i.e., the second folding that has affected the area), which, however, is older than the Cenozoic (or Upper (?) Cretaceous) coal beds of the region. One of these coal deposits was discovered in central Fosheim Peninsula, some 20 miles due east of the weather station (Fig. 10).

It was evident that the whole region had been covered by glacier ice during Pleistocene time, and evidence was found[1] that at one time this ice cover was continuous and that it had its centre, or centres, in eastern Ellesmere Island.

When the ice receded, the sea advanced across what is now the low plain of Fosheim Peninsula, as shown by numerous finds of shells. At Slidre Fiord the highest marine beach is now about 465 feet (measured by hand level) above sea level. The thick deposits of glacial till that cover the foothills of Sawtooth Range contain numerous fragments of shells along their contact with the raised sea bed of the plain. This, besides other evidence, indicates a relatively late advance of the glaciers, which apparently have ploughed up the old sea bed.

Botany

A collection of dried mosses and flowering plants was made during my stay at Eureka weather station. These plants are now being examined at the National Museum of Canada, but it is expected that the mosses will eventually be studied by Mr. Kjeld Holmen, of the Botanical Institute, University of Copenhagen. In addition collections of seeds of the Arctic poppy were made for Professor C. A. Jørgensen, of the Royal College of Agriculture in Copenhagen, who is working on the cytology and morphology of these plants, and of seeds of various grasses and cruciferous plants for cytological examination by Mr. Kjeld Holmen.

Zoology

Berlese funnel samples of the microfauna were processed for Dr. Marie Hammer (see *Arctic*, Vol. 2 (1949) p. 124), and a number of mosquitoes and other insects were brought back for Mr. Chr. Vibe of the Zoological Museum, University of Copenhagen.

As the area has rarely been visited a list of the wildlife observed may be of interest:

Muskox: Muskoxen are numerous on the plain of Fosheim Peninsula, and although their number is not known there appear to be as many as the land can support. It was apparent that the cows did not have calves every year.

Caribou: a tuft of white caribou hair, still attached to a bit of skin, was found on the ice in central Canyon Fiord.

Arctic hare: very abundant in certain places, particularly in the foothills of the lower mountain ranges.

Lemming: not much in evidence in the spring of 1952.

[1]On Stor Island in Eureka Sound, visited late in August.

Polar bear: no signs of bears were seen.
Wolf: wolves and fresh wolf tracks were occasionally seen. The wolves were fearless and on a few occasions even visited my camp.
Arctic fox: a small number were seen. Like the wolves, the foxes had no fear of man.
Weasel: about June 10, a weasel (in brown summer coat) was seen in Canyon Fiord.
Seals: frequently observed on the sea ice in Canyon Fiord, Greely Fiord, and Eureka Sound.
Birds: some of the birds of the region were unknown to me, and a complete list cannot be given. It may be mentioned however, that at the end of June a *black raven* was seen at the mouth of Slidre Fiord. The raven seems to be very rare in the region.

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Fig. 1. The campsite, September 1952.

PRELIMINARY REPORT ON SCIENTIFIC WORK ON "FLETCHER'S ICE ISLAND", T3

A. P. Crary*, R. D. Cotell*, and T. F. Sexton*

During March 1952, landings were made on T3, one of the large ice islands in the Arctic Ocean,[1] by a ski-equipped C 47 aircraft from Flight D of the 10th Air Rescue Service, Alaskan Air Command. Lt. Col. J. O. Fletcher, Dr. K. Rodahl, and Capt. M. Brinegar, from this command, remained on the island to reconnoitre and to construct a temporary campsite. During April, A. P. Crary and R. D. Cotell, civilian scientists from the U.S.A.F. Cambridge Research Center, and Capt. Paul Green, communications expert from the Alaskan Air Command, were landed on the island with their equipment, and Dr. Rodahl and Capt. Brinegar were taken off. By early May the permanent campsite, consisting of three Jamesway portable huts for living and working quarters, and snow or tarpaulin shelters for supplies, had been completed (Fig. 1).

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[1]Koenig, L. S., K. R. Greenaway, M. Dunbar, and G. Hattersley-Smith. "Arctic ice islands", *Arctic*, Vol. 5 (1952) pp. 67–103.

One of the main purposes of occupying the island was to install a meteorological station from which weather data could be sent out regularly for use in the synoptic weather maps throughout the arctic areas. These operations were under the command of Col. R. M. Gill, Commanding Officer of the 7th Weather Group at Elmendorf Air Force Base, Alaska. Although six-hourly surface weather observations were started on April 1, detailed weather studies were not begun until late June when a complete rawinsonde station and personnel of the 7th Weather Group were landed. Since that time upper air data have been taken twice daily, and surface weather observations hourly. In October regular snow observations and radiation studies were begun. At present there are nine men at the camp: six concerned with the operation of the weather station and three civilian scientists. The camp operations from late June until October were under 1st Lt. Robert Derrickson, who was replaced in October by Major H. G. Dorsey Jr.

The purpose of this report is to outline the scientific operations other than the meteorological work, which were in progress at "Fletcher's Ice Island" from April 1 to October 1 under the direction of the Geophysics Directorate of the Cambridge Research Center, and which, with minor modifications, are continuing. The program was generally directed along the following lines: study of the physical structure of the ice island, study of the movements of the ice island and of the ice pack, seismic profiling, and the collection of miscellaneous data.

Structure of the ice island

The island measures roughly 31 miles in circumference and is 5 miles across at its narrowest part, with most of the corners well rounded. The campsite is located about ½ mile from shore and 1½ miles from one of the corners. The most distant part of the island is about 7½ miles from camp.

Approximately 7 miles of transit survey have been made across the ice island, and elevations of the snow and ice surfaces were measured about every 350 feet. The ridge elevations are in general 20 to 25 feet above sea level, with the height of the ridges above the troughs varying from about 15 feet in a few places near the shore to an average of only 2 to 5 feet near the centre

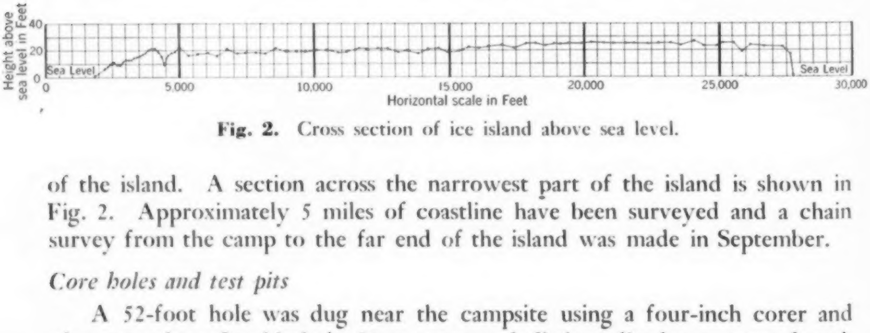

Fig. 2. Cross section of ice island above sea level.

of the island. A section across the narrowest part of the island is shown in Fig. 2. Approximately 5 miles of coastline have been surveyed and a chain survey from the camp to the far end of the island was made in September.

Core holes and test pits

A 52-foot hole was dug near the campsite using a four-inch corer and pipe extensions. In this hole 58 separate and distinct dirt layers were found.

Weights of the dirt were obtained for about half of these layers. The top, heavy layer, from two independent measurements, contained about 120 grams of dirt per square metre. Lower dirt layers at depths of 17.5 and 51.8 feet showed 18 and 15 grams per square metre, respectively, extrapolated from the area of the corer. These two layers were the largest of the lower ones. Many of the others contained less than one gram per square metre. These

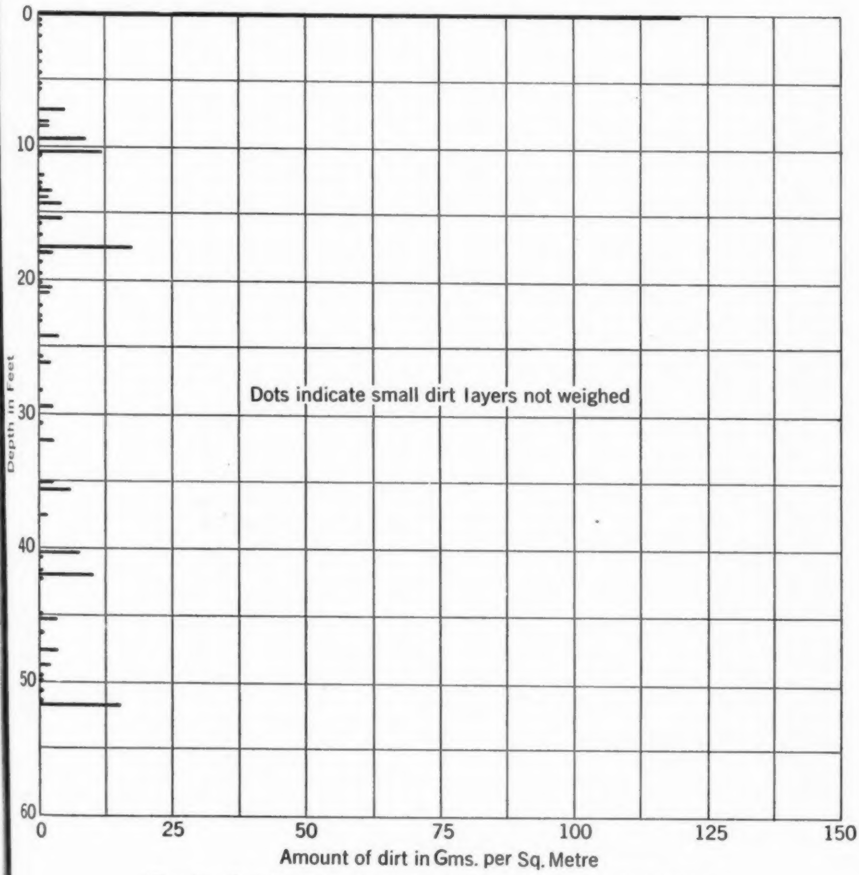

Fig. 3. Depths and weights of the dirt layers in a 52-foot hole.

weights are shown in Fig. 3. It is interesting to speculate that if the smallest dirt layer were considered to be representative of a single year's accumulation, it would appear that the present warm cycle has progressed for at least one hundred years to give the large surface layer. The larger of the lower dirt layers may also represent shorter warm cycles. A total of 29 samples in this hole were used for density determinations employing the immersion method;

the density values varied from 0.87 to 0.93 gram per cc. It is planned to use this hole for temperature measurements and to extend the borings as deep as practicable.

Seven sections between 50 and 300 feet in length, with core holes about 10 feet apart and to an average depth of about 3½ feet, were made across the top of ridges at right angles to the ridge trends. Nearly all sections showed a definite unconformity between the upper heavy dirt layer near the surface and the lower layers, with the upper layer parallel to the present ice level and

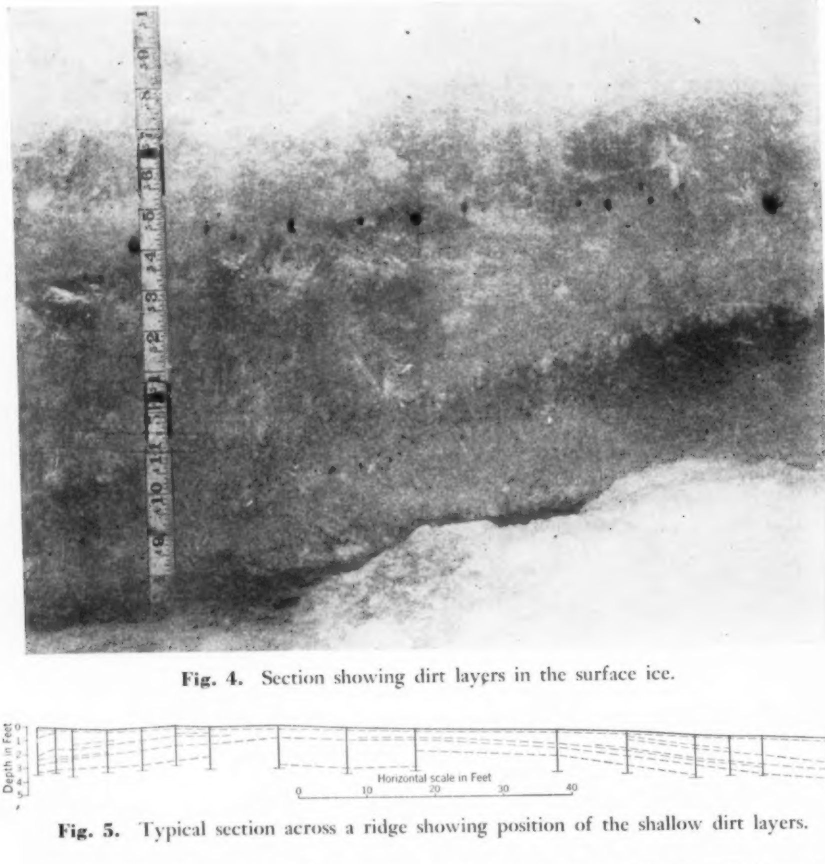

Fig. 4. Section showing dirt layers in the surface ice.

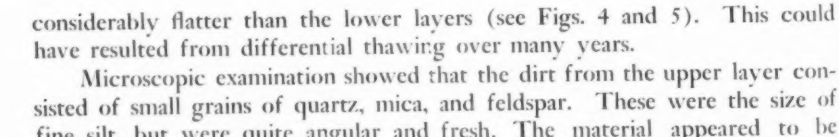

Fig. 5. Typical section across a ridge showing position of the shallow dirt layers.

considerably flatter than the lower layers (see Figs. 4 and 5). This could have resulted from differential thawing over many years.

Microscopic examination showed that the dirt from the upper layer consisted of small grains of quartz, mica, and feldspar. These were the size of fine silt, but were quite angular and fresh. The material appeared to be derived from a metamorphic granite-like land area. Sufficient amounts of dirt

from this top layer and from one of the lower layers have been obtained for age determinations of the organic matter present by Carbon 14 analysis.

Fresh water pockets

In two of the core holes made in the valley troughs before the thawing season, fresh water was found. In one there was 8 feet of ice over approximately 8 feet of water, and in the other about 3 feet of ice over 4 feet of water. This water proved very useful for camp purposes. At the first site, there were two distinct dirt layers in the 8 feet of ice. This may perhaps indicate that the water pocket formed three years ago, presumably when the island was at the southern end of its track.

Many large ice bumps or knobs occur on top of the ridges near the shores, and may have been caused by internal pressures associated with pockets of fresh water. These features are usually 2 to 3 feet high and some 5 to 10 feet in diameter.

Surface thawing

Range poles were frozen in the ice surface early in the season, but the extent of the thaw had been underestimated and the first reliable observations of surface thawing did not begin until the first week of July (Fig. 6). These

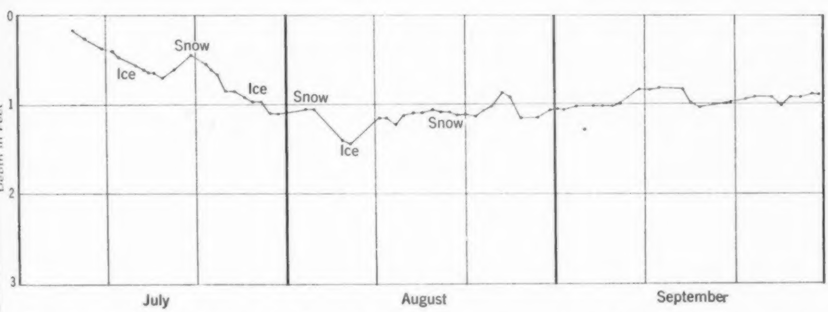

Fig. 6. Variation of the surface level during the summer months in the general campsite area.

indicate about one foot of melting on the ridges, a figure which was supported by visual observations around the campsite, though the latter may well be too large because of inevitable contamination of the surface by soot and other debris.

In general, the thaw period lasts from late June to mid August. Lakes appeared in all the troughs or hollows of the island, starting the first week in July (Fig. 7). From each lake channels led to other lakes (Fig. 8) and, eventually, to the sea. These narrow channels were filled with snow and were late in melting. Once they had melted through, the excess water from the lakes drained off quite rapidly. Following that, the runoff remained about the same, carrying off the excess meltwater as it formed. Later, in early August, the floor of the lakes melted down noticeably. Freezing started in late August,

Fig. 7. The ice island in early July showing the beginnings of lake formation.

Fig. 8. Narrow water channel typical of the many connecting the lake systems on the island.

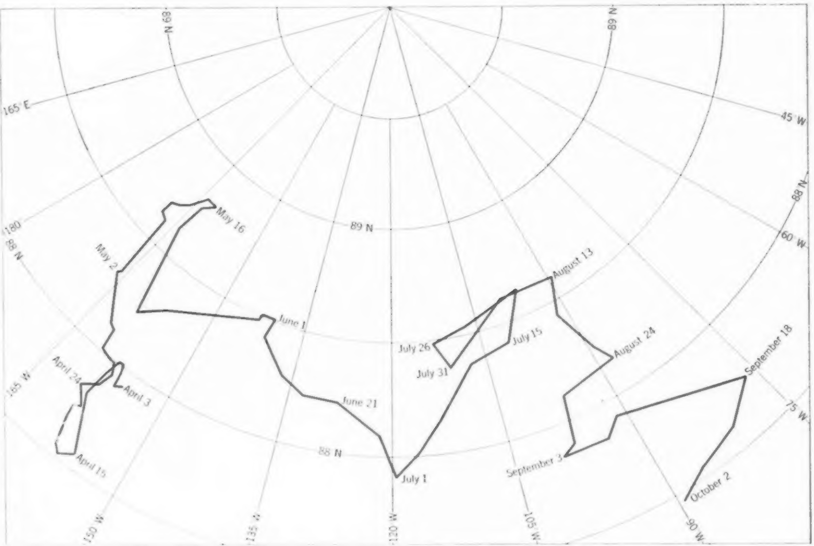

Fig. 9. Track of T3, April to October, 1952.

though the lake ice was not safe to walk on until the middle of September, and it was late October before it would support a C 47 ski-aircraft. Subsidence in the troughs where the lakes formed will be measured by drilling to known dirt layers after freezing of the lakes is complete.

Movements of the ice island and of the ice pack

Solar and lunar observations were made at frequent intervals with an engineering transit, and tentative locations (Fig. 9) were calculated approximately twice a week in order to provide a basis for the use of weather data. It now seems unlikely that the ice island will move out through the Greenland Sea along the route taken by the Russian North Pole Expedition of 1937–8. Movement is more likely toward the northern shore of Ellesmere Island, or toward the southwest to start another circuit through the Arctic Ocean.

At each of the solar observations, azimuths were obtained and the headings of the island were calculated on an approximate weekly basis for the orientation of the station anemometer and directional radio antennas. The island appeared to rotate very little on a grid basis, except for two periods during the summer—July 15 to August 1 and August 15 to September 10—when clockwise rotations of about 50 and 80 degrees respectively occurred. Figure 10 shows the changes of island azimuth to true and magnetic north, and the geographical longitudes.

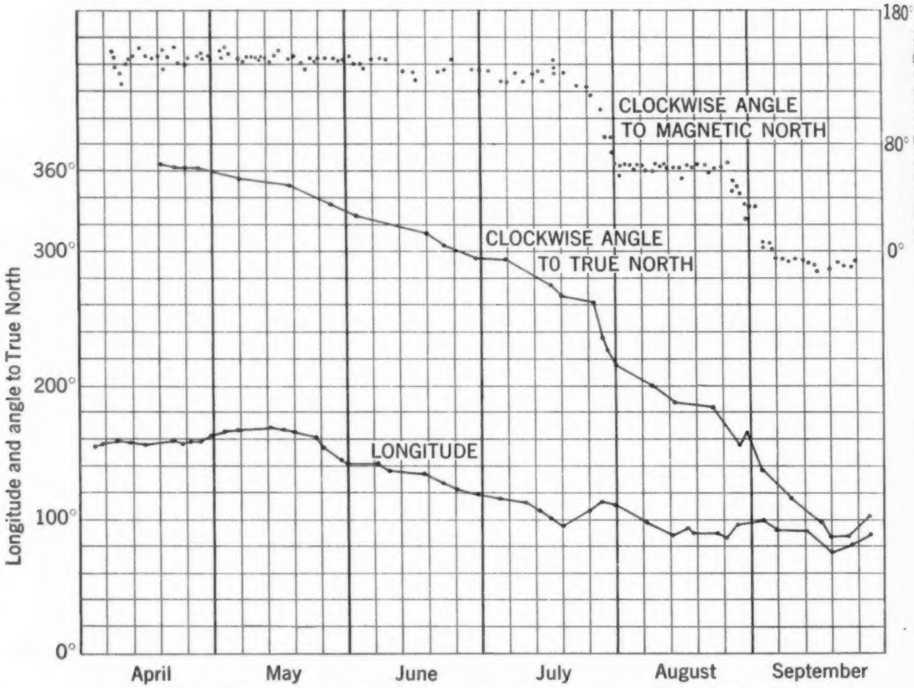

Fig. 10. Changes in orientation of the island in relation to a fixed reference.

Observations of the azimuth to magnetic north were made with a magnetic compass located about 300 yards from camp. These observations were made at 24-hour or, at times, at 12-hour intervals.

Several prominent ice hummocks 2 or 3 miles from the island edge were followed daily from two theodolites set up approximately ½ mile apart on the island. The most prominent hummock, about 25 feet high and 3 miles from the island, was followed from April to August when it toppled over during a heavy melting period. It is believed that the ice island movement does not vary much from that of the surrounding ice pack. The relative movements of these hummocks should also give important data on the stresses acting between the island and the ice pack.

Strain gauges, capable of measuring distance changes to 0.0001 inch, were set up between the ice pack and the ice island, on the island itself, and in cracks in the ice pack near the island. These observations indicate the nature of the internal stresses and will be used in the general study of the ice movements.

A sensitive bubble level, reading to 0.1 second of arc, was set up on a ridge near the campsite and read daily. An over-all tilt of about 2 minutes of arc was observed, which was noted to be dependent to a large extent on the wind speed and direction.

Measurements of the wind gradient over the ice island and over the ice pack have been made with three anemometers placed approximately at 5, 10, and 20 feet above the surface. Limited measurements have also been made of the positions of the weather station pibal balloons during the first minute of flight. From these, it is hoped to get indirect evidence of the wind stresses acting on the various ice surfaces.

A drag-type current meter was suspended through a hole in the sea ice, and readings were obtained of the relative motions of the ice and water at various depths to 1,500 feet. Regular measurements were also made at depths of 500 to 750 feet.

From all these observations it appears that the movements of the island are due mainly to the wind stresses at the surface, and that the magnitudes of any permanent ocean currents are small in this part of the Polar Basin.

Seismic and gravitational studies

A seismic profile near the centre of the ice island was completed to a distance of 15,000 feet with three-directional recordings, using high explosives as the source of seismic energy. A shear or transverse profile was also made in which the waves were generated by swinging a 150-pound rock against the face of an ice pit by means of a 25-foot A-frame. Good shear-wave arrival times were obtained to a distance of 1,500 feet at right angles to the ice pit. In addition to information on the character and thickness of the ice of the ice island, these tests yielded valuable data on propagation of seismic waves. Good high-velocity flexural waves[1] were obtained which should give an accurate depth measurement. A longitudinal wave of constant frequency was very prominent at long distances, and is as yet unidentified.

A single shot of 100 pounds of T.N.T. was fired on the ice surface of the island about 5½ miles from a vertical seismograph operating in the range of periods 1 to 5 seconds. An air–space coupled wave[2] was obtained which indicated a tentative thickness of about 160 feet.

An independent check on the thickness of the ice island was made by shooting ocean depths shots with the receiving instruments at various locations on the island and at sea level on the salt ice. Differences in times of arrival of the reflected wave from the ocean bottom allowed the ice thickness to be measured to the nearest 10 feet, as the vertical travel through ice is about 0.001 second faster per 10 feet than through salt water.

The relative acceleration of gravity was obtained twice daily, using a portable gravity meter. The differences were based on observations at the Thule, Greenland, and Fairbanks, Alaska, gravity stations. The gravity values increased along approaches to two sea mounts and also changed by about 50 milligals in passing over a large fault which was discovered on the ocean floor.

[1]Ewing, M. and A. P. Crary. "Propagation of elastic waves in ice, II" *Physics*, Vol. 5 (1934) pp. 181–4.

[2]Press, F. *et al.* "Air-coupled flexural waves in floating ice". *Trans. Amer. Geophys. Union*. Vol. 32 (1951) pp. 166–72.

In addition to the gravity values, this meter was used as a long-period vertical seismograph, with daily readings taken visually every 5 seconds over a 6-minute period, in order to establish the seismic motions of the island in the periods 10 to 50 seconds.

A short period vertical seismograph, operating in the range 1 to 5 seconds, was monitored for about 2 hours daily, starting in August. Although the noise level was too high to permit the reception of earthquake signals, the observations obtained will be correlated with the weather conditions. The noise level was large compared with land readings.

Oceanographic work

Approximately twice a week soundings were obtained of the ocean depth with a directional array of seismograph detectors, from which strike and dip of the ocean bottom and of the lower sub-bottom layers could be obtained. These soundings showed that the ocean floor in the area of the Polar Basin across which T3 drifted was very different from the deep regular basin previously suggested. Depths were greatest in the west, but a figure of as little as 5,000 feet was found in the east.

Two sea mounts were discovered in the western part of the drift area, where the general level of the ocean floor was 12,300 to 12,800 feet deep. Although the island did not drift directly over these mounts, depths of only 9,500 feet were obtained, with dips of 15 to 20 degrees. In the eastern part of the area of the drift, the dip was in general toward the southwest, averaging up to 5 or 6 degrees. A fault or escarpment is the main feature here, with about 3,000 to 5,000 feet downthrow to the northeast. Depths varied from 5,000 feet to 12,000 feet in this general area.

Two refraction shots, of 100 pounds of T.N.T. exploded at 100-foot depths in the water, were recorded approximately 8 miles away. These were made to determine the velocity, hence composition of the submarine rock deposits and their depths.

Detailed observations of salinity of the salt ice with depth were made monthly from cores taken on an 8- to 13-foot thick floe, immediately off the ice island. These observations will be continued for the complete annual cycle.

Twelve lowerings of a temperature-recording bathythermograph have been made from the ice island. These lowerings varied in depth from 1,500 to 3,500 feet, in each case being sufficient to reach the warm Atlantic waters at about 1,000 feet. A smaller temperature inversion of about ½ degree Fahrenheit has been noted on all thermographs at a depth of about 400 feet.

Miscellaneous collections

Most of the various samples of surface dirt, flora, and fauna were obtained during the melting season along the stream beds near the shore. The most interesting collections are as follows:

Large boulders of coarse gray and black granitic rock showing some evidence of metamorphism were found in an area extending about 3 miles along

Fig. 11. Rocks and gravel near a stream bed close to the shore of the island.

the far shore from the campsite (Fig. 11). Many smaller rocks were found in gravel piles and stream beds in this vicinity.

Wood particles, such as stems, twigs, plant blossoms, and root fibres, amounting to about 300 grams, with the largest piece about 15 grams, were found in a fairly limited area along the shore. Four small leaves approximately one cm. in length were found in one of the lower dirt layers.

Small mollusc shells about one cm. in diameter and slender hollow calcareous tubes, serpulas, about one cm. by one mm. were found in some quantity in the same general area as the wood particles.

Various bones from fish that must have been at least 30 cm. in length; a complete small fish, about 10 cm. long; two different specimens of animal remains, one apparently from a lemming; and a few larger bones, approximately 20 cm. by 2 cm. were found along the shore at various points on the island.

A complete set of caribou antlers (Fig. 12) was found about 3 miles from the camp. Although they were in an upright position, no skull was found, but pieces of skin, fur, and what appeared to be flesh were frozen in the ice nearby. A more complete excavation is planned for the next thaw season.

The above specimens are at present being studied. Many of them will be sent to the Lamont Geological Observatory, Columbia University, for age determinations by the Carbon 14 method.

Fig. 12. Sgt. J. Jones, U.S.A.F. radio operator, holding the caribou antlers found on the island.

Fauna

During the entire stay on T3, the only wildlife seen consisted of eight birds: two in June, four in July, and two in August. One of these was identified as a jaeger, another as either a Sabine's Gull or a Kittiwake.

Recent tracks of polar bear and arctic fox were noted on the island in April. However, the only large open leads were over 2 miles from the camp and were seldom visited by the scientific staff so our observations do not necessarily indicate any scarcity of animal life.

Surface sea life, consisting of gammerid amphipods (shrimp) and ctenophores (jellyfish), was observed in the open holes through the sea ice in early June.

In addition to the regular program of observations on the ice island, similar observations were made at three other points during brief visits in the early part of May. At a landing at the north pole scientific studies included ocean soundings (14,150 feet) and gravity observations, and sample bottles were left for long range ocean current observations. At a landing on the ice island T1, near the Ellesmere Island coast, corings were made at two places which showed dirt layers similar to those on T3, and about ½ mile of transit survey was run inland from the sea ice. Near Ward Hunt Island a landing

was made on the north Ellesmere Ice Shelf, and corings were made and transit surveys were taken across the large ice drifts west of the island.

The ice island has proved to be a good site for arctic research projects. Especially favourable is the period April to July when temperatures range from $-35°$ F to $+32°$ F, and days are generally fair with average winds of 5 to 10 mph. During the summer months, with the temperature varying only slightly from $+32°$ F, low clouds and fog were quite general and the lakes hindered easy access to all parts of the island. Most of the collections on the island were made in the period July 15 to August 15, particularly during the heaviest thawing period in the first week of August.

In October A. P. Crary and T. F. Sexton (who had replaced R. D. Cotell in June) returned to the Geophysical Research Directorate and their place on the island was taken by 2nd Lt. R. R. Shorey. Charles Horvath, marine biologist, from the University of Southern California, and Valentine Worthington, oceanographer, from Woods Hole Oceanographic Institution, were flown in to carry out special studies during the period October 1952 to January 1953. During 1953 it is planned to provide facilities for glaciologists in order to make a more thorough study of the ice structure of the island.

IDENTIFICATION OF PETITOT'S RIVIERE LA RONCIERE-LE NOURY*

J. K. Fraser

IN SPITE of the vastness of the northern portions of Canada's mainland, it is unusual that a river of one hundred and ninety miles in length should remain unexplored for some eighty years after its discovery. This is apparently what happened to a river discovered in 1868 by a French missionary who mapped its course during his explorations, but unfortunately never reached its mouth and consequently drew in the lower reaches and the outlet from hearsay. Later explorers found no river where he had placed it on the map, and were apt to conclude that it did not exist. Recent mapping from air photographs (Fig. 1) and geographical studies in the area have now probably vindicated this explorer and show that his maps were not as inaccurate as cartographers had believed. But it remains a mystery why intelligent travellers should conclude from one negative piece of evidence that the river was non-existent, especially when the rest of the map was found to be fairly accurate.

This river, now known as the Hornaday, drains part of the virtually unexplored country between Great Bear Lake and the coast of the Arctic Ocean. Access to the arctic coast was supplied to early explorers by the valleys of the Mackenzie and Coppermine rivers and consequently there was little reason at first to investigate and map the area between these rivers. The main migration routes of the caribou swing away to the Coppermine and Bathurst Inlet country to the east, and so only a few Eskimo occupy the northern coastal fringe, while the Hare and Yellowknife Indians living along the northern shores of Great Bear Lake seldom venture north of the tree line.

No explorer has searched here for gold and copper. No wealth of fur exists in the treeless lands north and south of the ribbon of spruce along the winding Horton River. This region has been almost by-passed in the exploration of the north and only in the last three years has it been photographed from the air and the drainage features added to the map.

The first white men entered the area from the west and visited only the coasts washed by the arctic waters. In 1826 the eastern detachment of Franklin's Second Expedition under the command of Dr. John Richardson examined and mapped most of the coastline from the Mackenzie River to the Coppermine (Franklin, 1828). The head of Darnley Bay was not explored, but they traversed the shores of Franklin Bay and a large river entering the sea from the west was given the name of Wilmot Horton River for the then

*Presented at the second annual meeting of the Canadian Association of Geographers, Quebec, 1952, and published with the permission of the Director, Geographical Branch, Department of Mines and Technical Surveys, Ottawa.

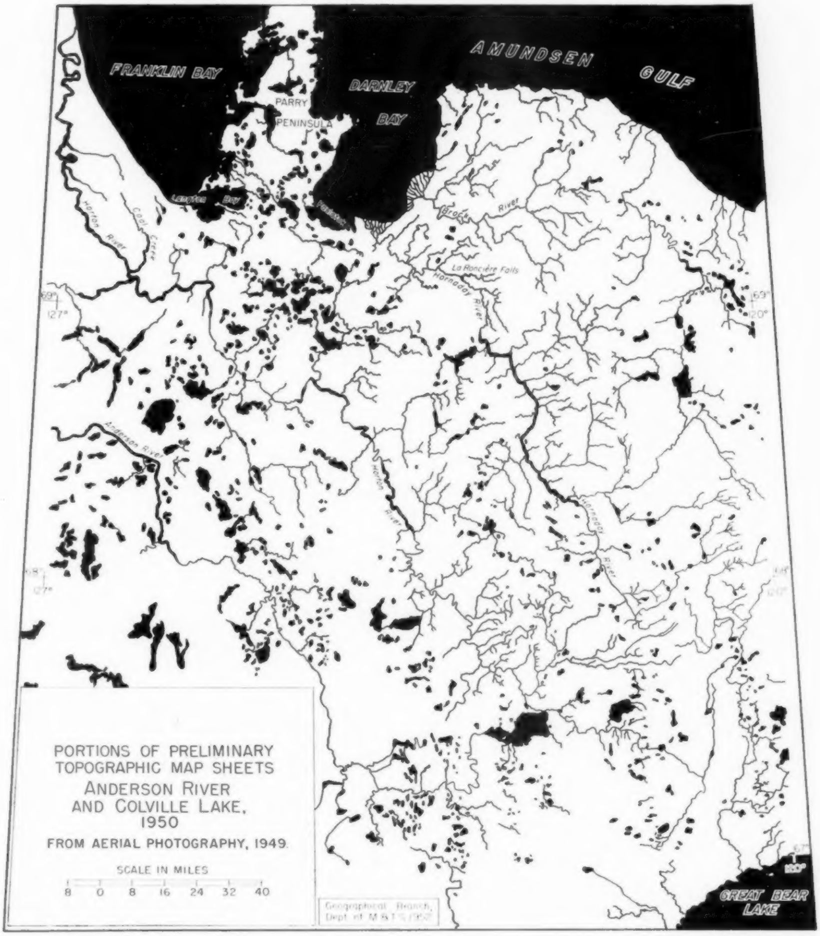

Fig. 1.

Under Secretary of State for the Colonial Department. Richardson (1851) again travelled along this coast in 1848 but ventured no farther into Darnley Bay than on his first voyage.

In the second half of the last century, traders and missionaries began to investigate the country adjacent to the Mackenzie valley, but few explorations were made north of Great Bear Lake. Roderick MacFarlane (1890) crossed the country between the Horton River and Franklin Bay four times between 1862 and 1865, and though he apparently produced no maps of his explorations, his discoveries were included in the maps prepared by l'abbé Emile Petitot, an Oblate missionary.

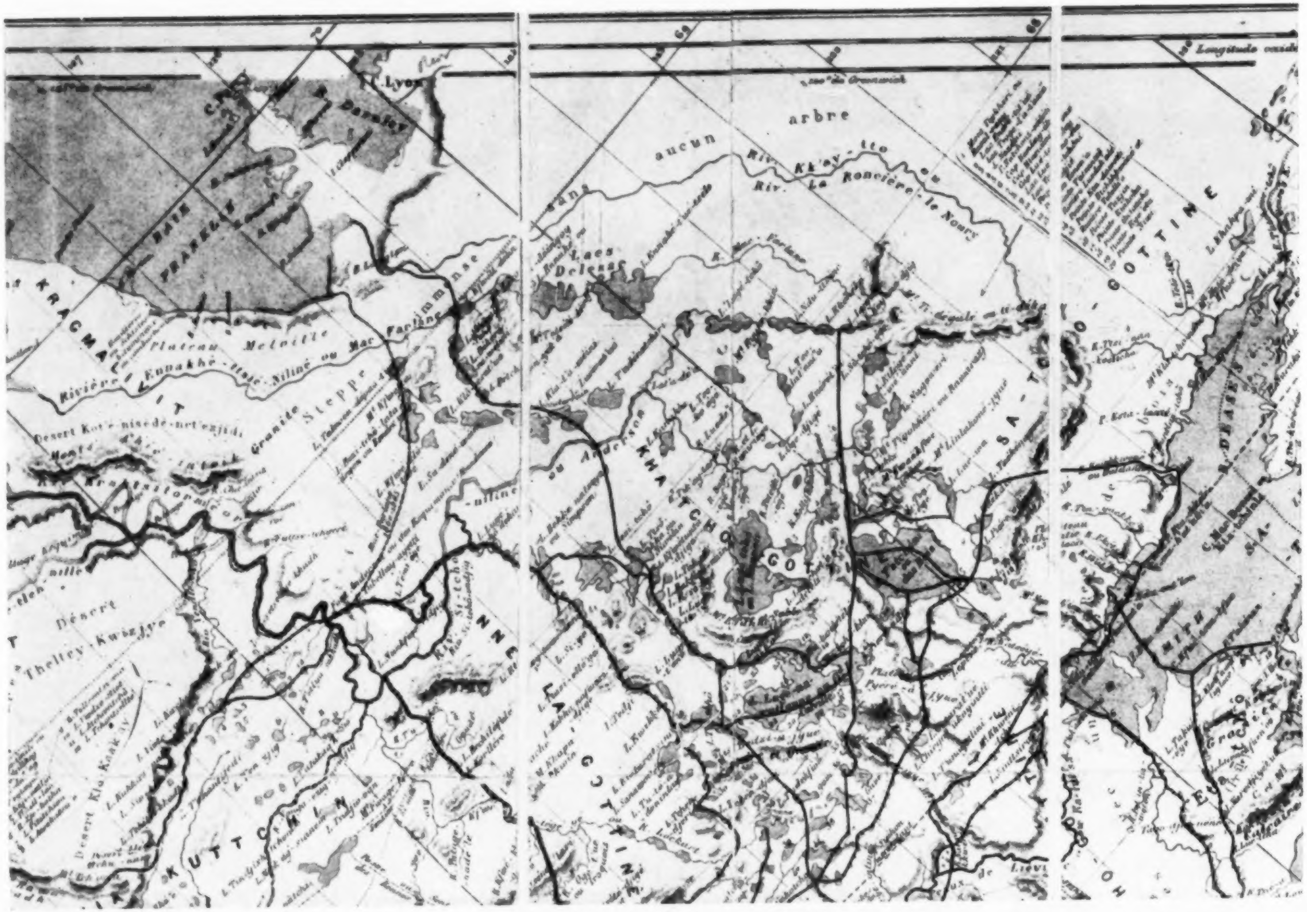

Fig. 2. Part of Petitot's map of 1875.

In 1875 Petitot published an account of his journeys to the north of Great Slave Lake in the *Bulletin de la Société de Géographie* in Paris. While Petitot did not reach the shores of Franklin or Darnley bays, he claimed to have visited, in 1867 and 1868, three rivers which flowed to the north and had their headwaters in the height-of-land between Great Bear Lake and the arctic coast. These rivers are identified in his memoir as the Anderson, the Mac-Farlane, and La Roncière-le Noury. His map of 1875 (Fig. 2) shows these rivers flowing generally parallel to each other to the north and northwest, the western two entering Liverpool Bay and La Roncière emptying into the southeast corner of Franklin Bay. The Wilmot Horton River discovered by Richardson is shown only as a short stream entering Franklin Bay in approximately the same position as that plotted by Richardson in 1826, and most probably was copied directly from Richardson's map.

The height-of-land north of Great Bear Lake was described by Petitot as being composed of limestone, apparently outcropping extensively and barren of vegetation. In the text, he calls it "la montagne Ti déray" and states that it rises some 800 to 1,000 feet above the surrounding plateau. He placed the source of the Roncière at approximately 120° west longitude on the eastern slope of "Ti déray", and continues in his description by stating that the Roncière enters Langton Bay at the head of Franklin Bay: "Sans former aucun lac ni aucun rapide". However, Petitot admits that he did not follow the river to its mouth and did not descend "le plateau élevé qui domine la mer à distance". He mentions heavy fogs on the Melville Plateau which often obscure the sight of the ocean. Following Petitot's publication, La Roncière-le Noury, which he named for l'amiral baron de La Roncière-le Noury was added to the maps and remained on them for some forty years.

Although whalers visited Franklin Bay after 1890, no scientific expedition which contributed to the maps again entered the area until 1899. During the spring of that year, A. J. Stone (1900), a naturalist working under the auspices of the American Museum of Natural History, made a four-month journey from the Mackenzie delta as far as some eighty miles past Cape Lyon. He investigated the shores of Franklin and Darnley bays and discovered the mouth of a large river entering the latter bay, which he named after William T. Hornaday, the Director of the New York Zoological Society. Stone was the first to find that no large river discharged into Langton Bay as shown on Petitot's map. Stone made no extensive surveys inland and the rest of his map of Darnley Bay is remarkably inaccurate, and despite the Wilmot Horton River having been clearly marked on both Richardson's and Petitot's maps, Stone "rediscovered" it and gave it the name of the Constable River, a name which was never adopted.

The Hornaday River was not revisited for fifteen years, but Petitot's "Mac-Farlane" River was soon found to be the upper course of the Horton. Between 1909 and 1912 Vilhjalmur Stefansson and Rudolph M. Anderson made numerous trips on foot and by dog sled around Franklin and Langton bays, along the Horton River and across Darnley Bay (Stefansson, 1913). Semi-permanent camps were made on Parry Peninsula, at Langton Bay, and

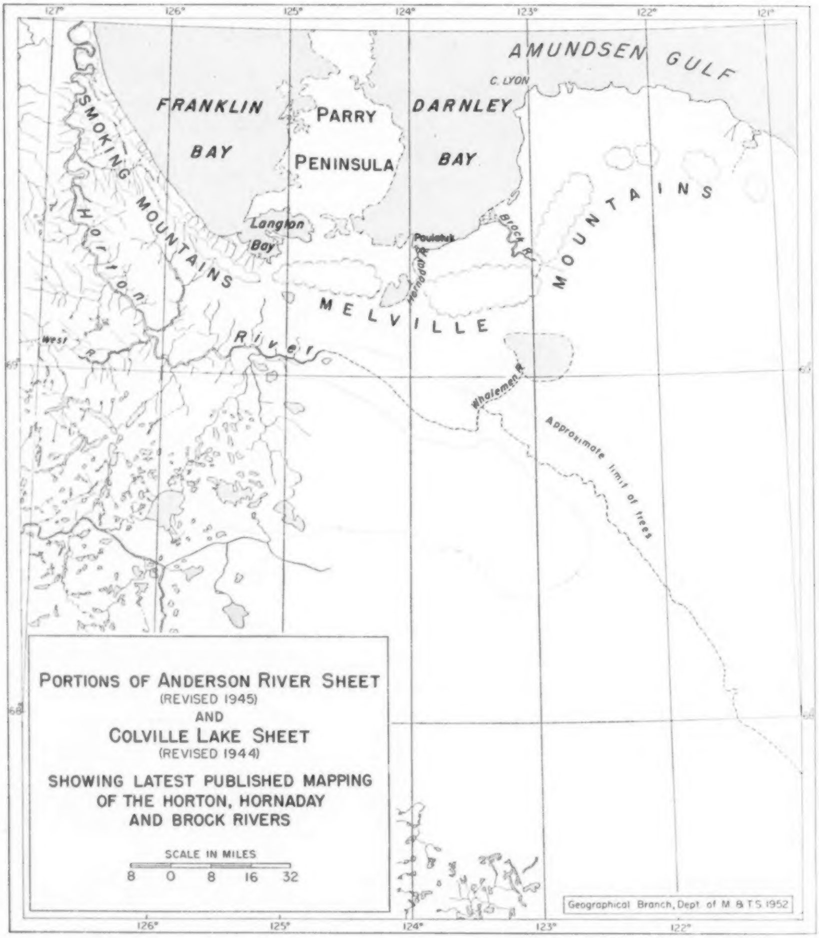

Fig. 3.

on Coal Creek, a small northern tributary of the Horton River. The general course of the Horton was added to the map from several trips made along the river and the latest published map of the area (1945) still shows the course which they plotted (Fig. 3).

Stefansson had hoped to find a large river and follow it inland. The reasons for this plan were that a boat of shallow draft could generally be used for some distance upstream and that usually a supply of willows and possibly spruce for fuel may be found along such a river valley. Examining the map he carried with him, he noted that Petitot's Roncière River was marked as entering Franklin Bay and therefore hoped to follow this river.

He writes: "we were now near the place where a large river, known as the 'River la Ronciere,' is drawn across the map with great detail as heading to the southeast several hundred miles away, near Bear Lake, and entering the Arctic Ocean at the foot of the Parry peninsula. The day we came to that part of the coast where the mouth of the river is laid down on the chart, we found, sure enough, that there was every appearance to indicate that this was the delta of a considerable river. There was a big bight filled with many low alluvial islands and the shores of these were strewn with willows and small spruce drift-wood, all of which might reasonably be supposed to come from such a river as the 'la Ronciere' is on the map." (1913, pp. 124–5).

However, further investigations up the river were disappointing, as the stream was small and apparently drained a small lake four or five miles inland. Stefansson therefore concluded that Petitot's Roncière River did not exist. He makes no mention in his book of the discoveries of Stone, and the Stefansson-Anderson party made no explorations immediately south of Darnley Bay, although Stefansson did cross the bay in 1911 and noted "two good-sized rivers that come into it from the southeast" (p. 321). These were, of course, the Hornaday and what was later called the Brock.

The delineation of the southern shores of Darnley Bay, omitted by Richardson, was not finished until 1915, when J. J. O'Neill and K. G. Chipman of the southern party of the Canadian Arctic Expedition of 1913–18 filled in the rest of the coastline. This expedition also fixed the position of the mouth of the Hornaday River, named the Brock River for Major R. W. Brock, a former Director of the Geological Survey, and made a short geological survey up the latter stream. No explorations were made up the Hornaday, which is still shown on the best available *published* map (see Fig. 3) as a short stream entering Darnley Bay and draining a large lake only a few miles inland. The Horton River entering Franklin Bay follows the indefinite course mapped by Stefansson and Anderson.

In 1949 the area was photographed from the air by the Royal Canadian Air Force. From these photographs the Topographical Survey has prepared preliminary maps on a scale of 8 miles to the inch. The Horton River is shown on these maps (Fig. 1) as a river 370 miles in length, flowing in generally the same position as the course mapped by Stefansson and Anderson. Paralleling the Horton to the east is the Hornaday River, entering Darnley Bay after flowing some 190 miles from its source at approximately 68°40N., 120°20W. The map shows the Hornaday flowing in a wide channel for some 65 miles in its middle course. Farther to the east, the Brock River enters Darnley Bay and is only about 70 miles in length.

Studies in the field have provided additional information about the nature of the rivers and their valleys. J. R. Mackay and J. K. Fraser during the summer of 1951 made two extensive traverses inland from Paulatuk, the Roman Catholic mission in Darnley Bay, on the west side of the Hornaday delta. On the first of these trips, they explored the country between the Hornaday and the Brock rivers, and visited the canyon of the Hornaday at a point some 40 miles from its mouth. Here the river flows swiftly through

Fig. 4. Looking south on a creek flowing into the Horton River in the distance.

Fig. 5. La Roncière Fall on the Hornaday River.

Photo: R.C.A.F.

Fig. 6. Oblique air photograph of part of the middle course of the Hornaday River, looking east.

a steep-sided canyon cut in level-bedded sandstones and limestones, and at one point plunges over a fall sixty feet in height (Fig. 5).[1] While flying over the river valley *en route* to Paulatuk and again on the flight out in September, it was noted that the canyon of the Hornaday extends upstream from the fall for another ten or fifteen miles, when it broadens out into the wide channel shown on Fig. 6.

The Hornaday is a fairly large river, but its volume is not as great as that of the Horton River which drains the country to the west (Fig. 7). Mackay and Fraser travelled overland to the Horton south of Parry Peninsula and noted one striking difference in the valleys of the two rivers. The Horton valley supports a comparatively dense cover of spruce, with some trees up to 30 feet in height (Fig. 4), while no spruce at all is found along the Hornaday River.

[1]The name La Roncière Fall was adopted for this feature by the Canadian Board on Geographical Names on 6 June 1952.

Photo: R.C.A.F.
Fig. 8. Old drainage channel south of Parry Peninsula, looking west.

northwest across the foot of Parry Peninsula (Fig. 8). It is probable, or at least possible, that the lower course of the river was drawn by Petitot from the descriptions given to him by the Hare Indians with whom he travelled. It is an interesting point that the Roncière River on Petitot's map entered Franklin Bay at the place where Stefansson found the signs of a large delta and where the air photographs show the outlet of a former drainage channel. It is unlikely that the Hare Indians made many trips down the Roncière to the sea because of their unfriendly relations with the Eskimo and the timidity associated with this Indian tribe, and it is possible that under winter conditions, the large valley leading towards Franklin Bay may have been regarded by them as the course followed by the river. When Petitot was drawing his map of the region north of Great Bear Lake, he may well have been told by the Indians that the Roncière entered Franklin Bay a little distance up the west coast.

We find further evidence in Petitot's memoir to support the Roncière-Hornaday relationship. Petitot placed the source of the Roncière at approxi-

Photo: R.C.A.F.

Fig. 7. Oblique air photograph of the upper Horton River, looking east.

It is suggested that Petitot's Rivière La Roncière-le Noury is what is now known as the Hornaday River. The evidence to support this opinion appears to be sufficiently convincing. Petitot apparently followed the upper reaches of the Hornaday where the river flows in its broad calm channel and did not descend it far enough to reach the falls and rapids where the river cuts through the sediments bounding the Melville Plateau on the south. Therefore the Oblate states that there were no rapids, which is quite probably true as far as he went. He admits that he did not descend the plateau and that fog hampered visibility.

Therefore Petitot must have added the lower course of the river to his map either by guesswork or hearsay and it is suggested from further evidence that the latter was the case. From his studies in the field and from examination of air photographs, Mackay concluded that at one time the Hornaday River drained to Franklin Bay through a wide well-defined valley running east–west some four or five miles south of the head of Darnley Bay and swinging to the

mately 120°W. From Fig. 1 it may be seen that the headwaters of the Hornaday rise at about 120°20W., only about 8 miles west of Petitot's position. Again, the missionary mentions in the text that the "Mac-Farlane" is a larger stream than the Roncière. Stefansson showed satisfactorily that the "Mac-Farlane" is actually the Horton and the recent maps bear this out. The relative sizes then of the Horton and the Hornaday agree with Petitot's statement and are corroborated by the investigations of Mackay and Fraser in 1951.

One final piece of evidence is the fact that on Petitot's map of 1875, he has written along the course of the Roncière, "sans aucun arbre". As noted by Mackay and Fraser, no spruce grow along the valley of the Hornaday River as they do in the valley of the Horton.

To summarize, the Rivière La Roncière-le Noury which was discovered in 1868 and placed on the map in 1875 by Emile Petitot, was believed by later explorers to be non-existent. These conclusions were mainly based on the fact that no river of this size entered the ocean where Petitot had marked it. Instead, another river, the Hornaday, was discovered entering Darnley Bay east of the supposed mouth of the Roncière, but this river was unexplored for many years beyond five or six miles from its mouth. It is suggested that the Roncière is the same river as the Hornaday and evidence has been advanced to support this opinion. Far from being non-existent, it appears that the Rivière La Roncière-le Noury of Emile Petitot has merely been mislaid for three quarters of a century.

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"SPEKK-FINGER" OR SEALER'S FINGER

Kaare Rodahl*

"SPEKK-FINGER" (blubber-finger) is the Norwegian name for a severe type of finger infection (cellulitis), which is common among persons engaged in arctic sealing. The disease is of considerable practical and financial importance to the sealing industry, since it may incapacitate a worker for several weeks at the height of the season.

"Spekk-finger" was first described in Norway by Bidenknap in 1907, but it has been known to Scandinavian sealers for generations. The name indicates that the disease is thought to have some connection with the blubber and it is generally attributed to an infectious agent in the seal. According to sealing captains the old seals are particularly likely to cause the infection and "spekk-finger" is said to be more common late in the season when the catch consists mainly of old seals. While it usually occurs among those skinning and handling the seals on the pack ice, or hauling skins and removing the blubber from the skin on board the sealing vessels, it may also occur among those handling seals or unsalted sealskins at sealing stations ashore. The condition is sometimes referred to as "seal finger" or "sealer's finger".

Recent figures show that "spekk-finger" is very common in the Norwegian sealing fleet (Waage, 1950). In 1950 over 10 per cent of the crew of the Norwegian sealing fleet working off Spitsbergen suffered from the disease. It appears to be less common in the sealing fields off Newfoundland and east Greenland, where only 2.5 per cent of the crew suffered from the disease in 1950. Here the catch consists mainly of young seals taken during the early part of the season.

"Spekk-finger" is also reported to be common in the Gulf of Bothnia (Candolin, 1949). In Greenland the east Greenlanders appear to possess some immunity (Höygaard, 1939), but Dr. A. Laurent-Christensen (personal communication, 1952) mentions seeing several cases of a similar infection among west Greenlanders, which they believed was caused by handling the "Redfish", *Sebastes marinus*, a deep-water fish. According to information obtained from Eskimo in Alaska severe hand infections resembling "spekk-finger" appear to be frequent among the coastal Eskimo. Although the disease apparently does not occur among antarctic whaling crews, where other infections are common, two cases have been reported during sealing in the Antarctic (Liavaag, 1940). A similar condition has also been observed among fishermen in Norway, among butchers in Canada, and among workers handling frozen meat at a bacon factory in south England.

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A typical case of "spekk-finger".

Symptoms

The clinical appearance may be described as follows: a sudden extremely painful swelling of the finger occurs, and the skin becomes reddish with a somewhat taut and shiny appearance. The affected area is soft and swollen due to a thick colourless fluid; in most cases there is no pus. The patient complains of severe local pain and stiffness in the neighbouring joints. Throbbing is very marked. In many cases the whole arm becomes swollen, and the axillary lymph glands may also be affected. Slight fever and increased sedimentation rate have been observed in "spekk-finger" patients (Waage, 1950). Permanent damage to the finger bones attributed to this condition has been demonstrated roentgenologically by Mathiesen, Häupl, and Thjötta (1935).

Cause of the disease

The etiology and pathogenesis are not as yet established. The infectious agent is presumed to enter the finger through small cuts in the skin, and the symptoms may develop after an incubation period varying from 3 to 21 days.

Several pathogenic organisms have been isolated by different investigators, without it being possible to establish their etiological role. Thjötta and Kvittingen (1949) isolated a red pigment producing micrococcus from two cases of "spekk-finger". The organism was markedly halophilic, and the cultures were non-pathogenic to ordinary laboratory animals such as guinea pigs or rabbits.

The resemblance of "spekk-finger" to erysipeloid has been emphasized by several workers, and the possibility that the infection may be caused by *Erysipelothrix rhusiopathiae* has been suggested by Dr. W. L. Jellison (personal communication, 1951). This organism, which is the cause of swine erysipelas, is known to cause infection in butchers and handlers of pork products and among fishermen along the Atlantic coast of the United States. Svenkerud, Rosted, and Thorshaug (1951) have described a disease in seals which they claim to be similar to swine erysipelas. It manifests itself by the presence of multiple haemorrhagic infiltrations in the subcutaneous blubber of the seal. Cell infiltration and small areas of necrosis were observed. The lesions may heal without leaving any trace, or small scars and pigmented spots may persist in the blubber tissue. In some cases they were able to isolate a gram-positive rod-shaped bacterium which was not pathogenic to the ordinary laboratory animals, including pigeons and pigs. They considered that the organism might be "referred to the family of *Corynebacteriaceae* Lehmann and Neumann and should be called *Corynebacterium phocae*."

Dr. J. M. Olds of Notre Dame Bay Memorial Hospital in Newfoundland (personal communication, 1951) has made cultures from seals on two expeditions to the Newfoundland sealing fields. He states: "In practically all cases I have recovered a very small Staphylococcus from the palpebral fissures, various other organisms from the hair and nose. As the seal finger usually occurs on the second or third finger, I think it likely that it could be caused by the men stowing away the pelts by inserting these two fingers in the palpebral fissures and dragging the pelts. I have amputated numbers of these fingers and cultured them both here and had them done in the Public Health Laboratory, and invariably it is morphologically the same organism."

Treatment

Amputation of the infected finger was often necessary until recent investigations showed that the condition could be successfully treated with modern antibiotics. In the past the sealing captains usually followed one of these treatments:

1. A covering bandage was saturated with camphor oil and kept in place for one or two days at a time according to the severity of the infection. A partial destruction of the tissue took place followed by healing.
2. White wheat flour was made into a paste with alcohol and spread on the infected finger. This treatment was less radical and less effective.
3. A thick layer of soft soap (sometimes mixed with ordinary washing soda) was spread on the infected hand. The covering bandage was saturated with hot water, and the whole hand or finger was from time to time placed in very hot water. Naturally, this treatment was extemely painful, but apparently quite effective.

In 1941 I treated six cases of "spekk-finger" successfully with "Rivanol" (2 ethoxy-6, 9, diaminoacridine lactate) solution while on an expedition to the sealing fields off Newfoundland (Rodahl, 1943). In one severe case sulfanilamides were applied in addition to the "Rivanol" treatment with fairly good results. In recent years penicillin has also been used in the treatment of

"spekk-finger" (Knap, 1945; Mathiesen, 1945). Waage (1950) treated 20 cases with aureomycin in 1950 and recommended that 12 to 16 doses of 250 mg. aureomycin should be given at 6-hour intervals. Following the first 3 to 4 doses the pain appeared to decrease markedly, and the recovery of those patients who did not have bone damage appeared to be complete one to two weeks after the conclusion of the aureomycin treatment. Olds (personal communication, 1951) has used penicillin, and also aureomycin in the treatment of "spekk-finger" and he writes: "Lately penicillin, and better, aureomycin, have saved many fingers."

Although treatment has been improved it is very desirable that a systematic study should be made of the nature of "spekk-finger". In order to follow all stages it is essential for the investigator to examine this infection in the field. This is often difficult on sealing vessels operating in the pack ice, as facilities are usually inadequate. While studying other problems in Alaska it occurred to me that if "spekk-finger" existed among the sealers on the Pribilof Islands it would provide a very good opportunity to study the condition as there is a biological laboratory in the village of St. Paul. I therefore paid a visit to the sealing station during the killing season in July 1951, where I saw a typical case of "spekk-finger" and was told of two previous cases among the biologists employed on research work.

Description of a case of "spekk-finger"

The patient was a 23-year-old biologist engaged in collecting specimens of both young and old seals (*Callorhinus ursinus*), such as snouts for odontological age determinations and tags from seal flippers, and in cleaning skulls and removing blubber from the skins. The sealers on the Pribilofs usually handle only 3-year-old males, in which infections are rare, while this biologist had also handled old bulls with heavily infected wounds and scars in their skins. Some time prior to the development of "spekk-finger" he had extracted a tooth from a seal which was infected with an apical abscess containing pus. It should be mentioned that he never wore gloves during his work.

On July 8 the biologist noticed an inflamed pinkish spot the size of a small pea on the ventral side of the first phalanx of the middle finger on his right hand. This spot was tender when touched, while the rest of the finger was painless. Three days later the entire finger was swollen. The pain was confined to the small pinkish area. The following morning one of the other biologists probed the finger with a scalpel, but no foreign body or pus was detected.

On July 14 the swelling became marked and the patient had severe pains in the finger particularly when stretched. By this time the whole finger was greatly swollen, the swelling extending to the knuckles of the metacarpal-phalangeal joints. The following day the first phalanx became reddish in colour; the patient was afebrile. Dr. Edwin Wilde, physician of the U.S. Fish and Wildlife Service, thought there was a deep-seated infection, so he made a deep incision in the middle of the ventral side of the first phalanx. It

bled profusely, but no pus was observed. Ichthyol was applied locally, and 400,000 units penicillin were given intramuscularly, as well as two sulfanilamide tablets every four hours.

When I examined the patient the following day, July 16, no localized tenderness could be detected, but attempts to straighten the finger caused severe pain. The finger was nearly twice normal size and the swelling also involved the dorsal side, including the soft tissue over the knuckles. There was a slight bluish-pink discolouration on the dorsal side of the finger.

The penicillin and sulfanilamide treatment was continued, but the symptoms progressed with increased swelling and severe constant pain. The patient stated that it felt as if the pain was seated in the bone. By July 18 the entire hand was swollen. Aureomycin was now given (1 gram daily), in addition to penicillin. A slight improvement was observed and by August 5, twenty-nine days after the first symptoms, the hand had returned to normal.

Histological examination of a tissue specimen taken from a drainage incision eight days after the first manifestation of clinical symptoms showed hypercornification and squamous cell thickening associated with chronic, non-specific inflammation of the dermis. In this connection, it may be mentioned that histological examination of a section from a deep infected wound in an old bull seal showed an active and chronic non-specific inflammatory reaction with leucocyte infiltration in the upper layer of the ulcer bed. Microscopical examination showed large numbers of small cocci and a very small number of gram-positive rod-shaped bacteria which morphologically resembled the organism described by Svenkerud, Rosted, and Thorshaug (1951).

Prevention

Although "spekk-finger" has never been reported among the natives on the Pribilof Islands, I was told that they consider finger infections occurring during the handling of seals to be very malignant, and great care is always taken to treat cuts and wounds in the hand during the sealing season.

The reason for the rare occurrence of "spekk-finger" among the sealers on the Pribilof Islands, as compared with sealing crews operating in the pack ice, may be as follows: better conditions for personal hygiene; better facilities for immediate treatment of cuts and wounds on the hands during the handling of the seals; different technique in the killing and skinning of the seals and in the removal of the blubber from the skins; and finally the fact that only young seals are handled.

As "spekk-finger" is extremely painful and may incapacitate the patient for several weeks, possibly even resulting in ankylosis and loss of function, it is important to take all possible precautions against the infection. In the case of sealing crews operating in the pack ice, sufficient hot water and soap and effective disinfectants should be readily available to enable the crew to wash their hands as often as possible. Small wounds and cuts should be promptly treated and adequately protected from direct contact with the seals. General experience is that "spekk-finger" occurs most frequently among the

men who take little personal care, and who seldom wash their hands. The work on the ice often makes it impossible, however, for the crew to wash their hands until the end of the day. Washing is also frequently difficult for northern travellers, but it should be remembered that aged seals are particularly likely to cause the infection and that the earlier a case of "spekk-finger" is recognized, the greater is the chance of healing without complications.

Although "spekk-finger" is extremely rare among the sealers at the Pribilof Islands, and thus represents no serious problem at this station, the fact that it does occur offers an excellent opportunity for further studies of the nature of this disease.

I am greatly indebted to Dr. E. Wilde of the U.S. Fish and Wildlife Service, physician at St. Paul, Pribilof Islands, for his assistance in obtaining histological specimens and to Dr. H. D. Chipps, University of Washington, for the histological examination of the tissue specimens. I should also like to thank Dr. J. M. Olds, Medical Director of Notre Dame Memorial Bay Hospital, Newfoundland, and Dr. W. L. Jellison of the Rocky Mountain Laboratory for valuable information on "spekk-finger".

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THE RUSSIAN ARCTIC SEA LANE: ENDEAVOUR AND ACHIEVEMENT

THE NORTHERN SEA ROUTE: Soviet exploration of the North East Passage. By TERENCE ARMSTRONG. *Cambridge: Scott Polar Research Institute (Sp. Publn. No. 1), 1952. 9½ x 6½ inches; xiii + 162 pages; illustrations, sketch-maps, and folding map. 21s. [In Canada, Macmillan Company, $4.00].*

It is four hundred years since the notion of Northwest and Northeast Passages was conceived in Western Europe. Yet it is only within the last two decades that spectacular results have been achieved in the pursuit of this idea. In the American North, the Northwest Passage has been barely conquered. In the Soviet North, a useful sea lane, called the "Northern Sea Route", has been developed. After so many years, it is not surprising that the West is still asking questions about the Russian success.

It is unfortunate that the available facts admit of little more than historical presentation. But Mr. Armstrong confines his historical survey to the period prior to 1933. Thereafter, undaunted, he marshals his data under the headings of physical characteristics, traffic, administration, equipment, and scientific support, in order to make a sustained and courageous effort at analysis. The result is more than an exhaustive collation, and a number of interesting conclusions, convincingly documented; it is the author's especial achievement, that, working with scanty and rapidly aging materials, he provides or adumbrates the answers to many major questions.

The subtitle of this study emphasizes that there is a long record of navigation in Russian Arctic waters. This is to be digested before one approaches the Soviet achievement. It is a somewhat tangled story. There were voyages which were made both by Russians and by non-Russians; which were inspired by economic, scientific, or strategic ends, or by a mixture of these; and which were confined to one or more sectors of the Russian Arctic, as well as directed along the entire northern coast of Russia. An outline of events in each of three regions unravels the skein. Most important is the Kara Sea, which was penetrated from the West. There is the sector east of the Lena, which was entered from the Pacific. Finally, there is the central sector, and the difficult navigation around the Poluostrov Taymyr (Taymyr Peninsula). It is a treatment by which the few attempts to sail the entire Northeast Passage are left for the reader in easy isolation.

Russian navigation in arctic waters apparently dates from the ninth century, but this was confined, in all probability, to the Barents Sea. This fascinating, but less relevant mediaeval link in the story is omitted. It is sufficient for the narrative to begin in the first half of the sixteenth century, to show that Russian vessels were already in the Kara Sea, and probably also in the Laptev Sea before mariners from Western Europe first entered the waters of the Barents in their search for a sea route to China. But these vessels were manned by traders from the White Sea coast, where the expanding Russians first debouched on the arctic seas. They were exploiting what a later age might have called a "Sable Coast", and none are known to have dreamed of an Orient beyond. Nevertheless, it emerges that the native contribution to navigation in Russian Arctic waters is very old and that it is important. It also develops that the Soviet government did not discover the Northeast Passage, and was not the first Russian administration to commission voyages along the entire route.

If the reader is grateful for a clarification of the confusing maritime history of the Russian Arctic, he is especially indebted for the story of operations in the Kara Sea. Of all the activities in the waters north of Russia, these were and probably remain unique for their commercial importance. Appropriately, they occupy almost

one-fifth of the book. Many will be surprised at the revelation that the Kara Sea route emerged from the pioneer stage as long ago as 1905, and to learn that one resolute businessman, only eleven years later, was enjoying profits of 40 per cent. Given such a return, and a diminishing risk, there is no surprise that the Revolution failed to stop the Kara trade, but merely altered the form of capital involved and substituted a different source of initiative.

The physiographical study of the Russian Arctic, done prior to 1933, is also briefly reviewed. By lumping scientific work done before 1917 and 1933, and by juxtaposing this with what followed, the author inevitably magnifies the lack of plan and "cohesion" in the earlier periods. One is clearly invited to a definite historical judgment which some may be reluctant to accept without a comparison of contemporary work in Scandinavia and North America.

The survey ends at a notable juncture in the development of the Russian Arctic, the establishment of the Chief Administration of the Northern Sea Route (G.U.S.M.P.) in late 1932. This act by the Soviet government has great importance in several respects.

Over one of these, its timing, the author does well to pause. He is apparently unable to say whether the founding of the G.U.S.M.P. coincided with an increase in planned expenditure on either the Northern Sea Route or on the North in general. He implies what is probable, that planned expenditure on the Route was intended to rise. He rightly dismisses the possibility of such a decision during the 'twenties, a period of reconstruction. He notes that the first steps toward the industrialization of the U.S.S.R. had not been completed until the end of the First Five Year Plan in 1932. He points to the desirability of coordinating the planned development of the shipping lane and of the Subarctic with that of the rest of the country during the ensuing quinquennium. But the relevance of a jejune industry to the birth of a major effort in the North after 1932 may be called in question. It would seem that demands placed by the development of the North on basic industry have ever been slender; and it would seem that coordination with the first national plan would have been equally desirable, for the government had long been active in the region. The question remains: why, when other projects were urgently needed, did the government begin a serious effort to develop the Northern Sea Route? One possibility has not been explored, and, indeed, defies examination. We know that expenditures during the First Five Year Plan lagged behind those planned, apparently due to the lack of capital equipment. In 1933 it is possible that inputs critical to more urgent projects were in short supply, whereas inputs useful in the North, such as forced labour, were in surfeit.

The higher policy of the Soviet press is, explicitly, the repudiation of failure and the celebration of success. The former is achieved largely by silence, the latter by the announcement of plans conceived and fulfilled. The difficulty is as much to detect defeat as it is to evaluate success. To equate the appearance of the G.U.S.M.P. with that of a plan for the North is perhaps to succumb to the sources. The evidence relative to the Subarctic as a whole, rather than to the Northern Sea Route alone, suggests that the coordination of a northern program under the G.U.S.M.P. points to the failure of the First Five Year Plan in the North. It is apparent that an effort *was* made to apply the essential features of the plan throughout the country as a whole, and that most efforts in the North were inarticulate and premature. Despite the name, the *Komseverput'* seems to have done little about the Northern Sea Route between 1923 and 1932. Obviously, the lessons to be learned were many and costly. Not the least was the fact that the government was faced with a peculiar problem in applying its plan throughout a vast region. It was unable to define this region, and this problem, until about 1932. Thereafter, the directions taken in the North were uniform with those already taken elsewhere during the previous plan. That the government made the new agency responsible for the Northern Sea Route also responsible for its plan in most of the Subarctic

suggests that it viewed the Route as the key to its problem. Whether or not one is justified in seeing more than a merely convenient association of the two developments, it is clear that the establishment of the G.U.S.M.P. did not mark the inception of planning in the North, but that it marked rather an effort to improve the implementation of a plan, to increase control.

Of the two important functions of government in a planned society, implementation is vastly more difficult than prognostication. For the former involves the erection of a complex mechanism of controls. In both respects, the whole Soviet experiment is instructive. In the former respect, the G.U.S.M.P. emerges implicitly from this study as an especially interesting case-history. Broadly speaking, the Soviet administrative pattern had crystallized by 1932. It was marked, as had been expected, by a phenomenal degree of centralization. Planning, perforce, was tightly concentrated at the centre. It is true that each enterprise still had a contribution to make, but this was little more than a conservative forecast, based on local knowledge, and utilized by the centre as a confirmatory source of information. In the field of control, the degree of centralization already achieved was equalled only by the boldness of the effort to this end. Decentralization was accepted only along functional lines, and existed, essentially, at only one level, the Council of People's Commissars. The larger function of the Commissariats was control, and each retained, and exercized, a power of prescription which was and remains unknown outside the Soviet polity. Under the circumstances, it is difficult to understand the statement that: "An organisation is set up in order to shape events rather than co-ordinate work already being done" (p. 54).

Before 1933, the Soviet North was thus subject to parallel channels of control, operating downward through various federal, provincial, republican, and local authorities. There was, in addition, an "actionary" company, the primary purpose of which appeared to be still dimly connected with the development of the Northern Sea Route. This was one of several relics of pre-Revolutionary trading practice which had been retained in the 'twenties, as the book shows, only to facilitate certain regional operations involving several commissariats. After 1929, as the book does not show, these were subject to liquidation during the First Five Year Plan. A capitalistic victim was involved in a socialist prosecution. It is impossible to say whether this particular company was more inefficient than many other similar or nationalized enterprises; and it is possible that the charges that it was inefficient (p. 22) were little more than the typical Soviet *odium theologicum.* After four years of blundering effort, it is highly conceivable that the situation called for an inter-ministerial organ to coordinate operations in a region newly recognized as homogeneous. The *Komseverput'* had been expanding; but national policy called for its demise, and existing controls had to be fused otherwise. The Russian administrative system was dynamic and experimental. The compromise which it threw up was a curious Chief Administration. It lacked a ministerial "home", but, in the Soviet administrative hierarchy, it was only one rank below a commissariat; it was given the rare status of direct attachment to the Council of People's Commissars, and, as such, it was a vastly more powerful body than any previously active in the North. The circumstances of the birth of the G.U.S.M.P. suggest increasing centralization of control. A fact of some importance for the timing of the step, as well as for other questions, is obscured, if it is denied that planning was attempted in the North prior to 1932. If, given its complexity and power, the G.U.S.M.P. was also to any degree autonomous in the field of planning, it is strange that no "planning" or "projects" administration was set up (pp. 55, ff).

The circumstances of the drastic reorganization after 1937 are similarly interesting. Some apologists may suggest that the failure of that year was partly due to too much decentralization. That a large measure of this existed, as the author believes (p. 57) is debatable. In the G.U.S.M.P. of the Second Five Year Plan, we have an organization responsible for a gigantic empire embracing only less than

one-third of the U.S.S.R., as well as for the Northern Sea Route. Under an administration ambitious beyond its capacity, this involved obligations perhaps as great, if not greater than those ever assumed by a single institution of its status. In the Soviet system, as we have noted, these obligations had long been subject to central control which was delegated between various commissariats and their subordinate territorial authorities. Against the background of a proven administrative system, the old G.U.S.M.P. emerges as an anomalous regional authority unique in the Soviet political scene. That its reorganization took the form of a redistribution of all its duties not directly related to the Northern Sea Route among orthodox channels of control, and that this coincided with the appearance in the State Planning Commission of branches specifically concerned with the North and the Route, suggests that within four years too much centralization had been achieved. Altogether, on the part of a nation with a considerable experience in the definition, administration, and development of regions, we have an interesting failure to evolve a single regional authority for the North.

In the economic context, the most troublesome questions put to the evidence by Western observers generally reduce to profitableness. Has the effort expended on the Northern Sea Route been repaid? In so far as the Russians occasionally pay lip service to basic economic concepts, the evidence has certainly been adduced. But it proves intractable, and a good deal less suggestive than even this careful study makes it appear. There is no doubt that the Kara Sea route was profitable prior to 1917. The author concludes that it was profitable in the 'twenties also, especially in the export of timber. But Voyevodin's figures, quoted in this connection (p. 21), are not entirely convincing. For behind these there lay already a peculiar Russian policy for the formation of prices and freight rates, as well as monumental mismanagement. Tempting as these are to the data-hungry West, who can be certain whether these exaggerate, or even depreciate the margin ostensibly in favour of the Kara Sea route? The author admits the impossibility of determining the effectiveness of early Soviet investment in this route (p. 22). In any case, such figures are intrinsically incapable of supporting the strong presumption that, profitable or not, the route had value in that it carried freights which at that time simply could not be carried otherwise, economically or not. In this connection, there are probably figures available which might hint whether the quantities so moved were, or were not, of national importance. At this point, it is well to remember that, however impressive the Kara Sea route as an historical antecedent of the Northern Sea Route, its profitableness has never implied that of the Northern Sea Route as a whole.

After the inception of planning in 1928, one must begin with a notion of profit which has uncertain connotations in the Soviet planned economy, in both the short term and the long. Short term profits are planned profits, they seem to bear no relationship with an initial capital investment, they vary between industries making producer goods and those making consumer goods, and the manner of their determination is obscure. Nevertheless, the drive to achieve *rentabelnost'*, which the Russians define in a typical circumlocution as "purposiveness in the economic sense", is an old one. But two things seem clear: profits exist and constitute some kind of return to an investment; and this return is widely and energetically pursued in both the short term and the long. Thus far, the author appears to be justified in searching the more specific evidence for profitableness. But it is not strictly true to say that profit, even in the short term, is irrelevant in the Soviet Union (pp. 103, 112).

The question of subsidies is apposite, and is raised at this point (p. 113). In this context, it merits perhaps slightly fuller treatment than it has received. In literature concerning Soviet economics, the term has been subject to some loose usage. Major capital construction is financed out of the budget through non-repayable, non-interest bearing appropriations. The broad assumption is that an

enterprise emerges from the pioneering stage when it ceases to require a regular appropriation. It would seem to be such an appropriation which is referred to as the "subsidy" out of which 90 per cent of the employees of the Moscow office of the G.U.S.M.P. were to be paid (p. 113). In addition, the state has found it necessary to support already established industries with more or less extemporized annual grants (*dotatsii*). In the Soviet system, it is probably only these which merit the name "subsidies". In 1936 an effort was made to extirpate all of these "subsidies", and it was made clear that only a small number of enterprises which were considered vital to the state should continue to receive these, i.e., should be permitted an extended or continuous failure to achieve *rentabelnost'*. It is doubtful that the effort has ever been successful. Three years later, the Eighteenth Party Congress was characterized by a number of public commitments by various enterprises to operate without "subsidies". If, under the circumstances, Papanin on this occasion also referred to a *dotatsiya* (p. 113), he said little of the profitableness of the fleet of the G.U.S.M.P.

In several passages the author refers to the application of *khozraschet*, the Soviet cost-accounting system, to various units of the G.U.S.M.P. He explains the extension of this system to further units in 1939 merely in terms of attention to costs, thereby emphasizing that, contrary to the Western assumption, to reduce costs in the Soviet system is not necessarily likely to raise profits. This is a formally inadequate definition of the system, but embodies that aspect which is popularly stressed. An enterprise is not beset with the repayment of an initial investment in itself; indeed, it appears that even amortization rates have often been set too low. We are far short of an incentive to economic operations; we are very far short of an incentive toward profits. As the author says, *khozraschet* becomes little more than another device to reduce operating expenditures. It is forlornly optimistic to cite its introduction, and a fashionable promise to try to forego a "subsidy", in the context of "the possibility of making the Northern Sea Route a paying proposition" (p. 47) and of steps toward making ends meet (p. 113). The system also has legal implications: the application of *khozraschet* loses even some of its residual power to suggest economic progress if it is remembered that those units of the G.U.S.M.P. which applied it earliest were probably the first to need legal personality.

One continues to ask the exact meaning of the year of "trial exploitation" (p. 43), of a "normally working" sea route (pp. 43, 59), of "normal commercial exploitation" (p. 47), and of "the first season of trial commercial exploitation" (p. 113). To these questions, the evidence maintains a stubborn silence. It is a silence which does not allay the suspicion that it was such questions which led to the castigation of B. V. Lavrov (p. 113) and to the dissolution of the Institute of Economics of the North (p. 61).

In the long term, the Northern Sea Route remains one more example of the puzzling manner in which the Soviet system disregards costs and courts, perhaps, production. The Stalinist truism that profitableness must be judged from the standpoint of the economy of the whole nation and over a period of several years is quoted on p. 103 and is typically evasive and unhelpful. Yet post-war theoretical literature seems to reveal that no satisfactory method of arriving at such a judgment has yet been worked out; and one wonders how Soviet planners[1] do their job. We are compelled to examine the apparent usefulness of the Route to the nation as a whole. First, there are those resources which, without the Route, might not otherwise be exploited. Many of these have long been the object of a general search, by which Russia has tried to insulate herself from the world market and to achieve strategic self-sufficiency. It is clear that the ability to sail into all sectors, and to

[1]On the eve of the Nineteenth All-Union Congress of the Communist Party, held last October, Stalin made it clear that in his opinion, despite years of official pressure, his economists have not yet produced a theory to explain the planned economy of the U.S.S.R.

pass from one sector to another, has expedited the exploitation of these resources. One is tempted to ask, however, whether any of these resources really owe their use to a through sea lane, and whether the gigantic organization set up to create this was really necessary. Timber can be, and was, exported from the Yenisey without a Northern Sea Route. After two decades, there is still no sign of either the need or the intention to export from commercially useful timberlands farther east. Is the availability of coal to arctic shipping ultimately dependent on a through route? The history of arctic navigation suggests that Nordvik salt could have been delivered to the Pacific fisheries without a G.U.S.M.P. The author has looked hard, but apparently in vain, for evidence to substantiate the Soviet claim that subarctic minerals are carried by the Route. Nor is the Northern Sea Route apparently necessary for the use of those river systems which drain into the Arctic. Again, the past suggests that operations to all these estuaries could have been more modestly coordinated from the west and from the east, and perhaps all the necessary scientific work could have been brought together, by, say, the commissariat controlling the merchant fleet. Second, there is no evidence that the Northern Sea Route has seriously relieved the Trans-Siberian Railway. It is strange that the extensive literature on the need to reduce long hauls by rail, and therefore the transport component in commodity prices, has never once referred to the magnificent effort to build a Northern Sea Route. One suspects a certain sophistry in the data given by Ioffe and Shmidt (p. 107). While Papanin could claim that sea freights to Yakutiya were cheaper than rail freights, it is interesting to note that the Trans-Siberian may have since been linked with Bratsk and even Ust-Kut' (p. 109), i.e., that the extension of the railway to the navigable headwaters of the Lena has nevertheless been found necessary. This is merely consistent with the fact that developments planned in the southern portions of the Subarctic still seem vastly greater than any achieved or planned farther north. *Dal'stroy*, an organization operating in the northeast of Siberia, seems to have swung over at an early date to the use of an overland road, and to have allowed the development of Ambarchik to lag. All of this seems to add up, strictly speaking, to the non-essentiality of the Northern Sea Route, so far as the resources of the hinterland are concerned, and, second, to non-profitableness in this respect in the long term.

The apparent failure of the Northern Sea Route to achieve profitableness suggests more than the collapse of a hope. It raises the question as to how careful Soviet planning has been. In an age of Colombo Plans and Tennessee Valley Authorities, it is a question whether a peculiar attitude toward costs, rather than careful planning (p. 37), remains the truly essential feature of the Soviet attack on the North. In a nation noisily committed to "the good life", this attitude toward costs argues either an incredibly secular stupidity, or some all-encompassing motive other than profit.

Towards the close of the book, the author reveals his quiet concern about the motives of the Soviet government in developing the Northern Sea Route. Although it has not repaid the effort (p. 112), he concludes that the initial motive was economic (p. 117). He reaches this conclusion by an approach which is carefully confined to an inductive estimate of the usefulness of the Route to the country. His handling of the evidence relative to the economic motive may be generally sound. The same method, applied to the strategic motive, however, is inadequate. As the author says, the necessary evidence is lacking. But obvious strategic usefulness is not the only criterion—in the case of the U.S.S.R. it is a most unlikely criterion—of the strength of the strategic motive. Elsewhere, the book does bring evidence which can be construed as indicating a very strong, if not predominant strategic motive.

We go back to the early years of the present century. On the one hand, there has been no digression to emphasize the "urge to the sea", infecting a nation whose maritime frontiers were twice as long as her land borders, and who was

deeply conscious of her limitations as a land power. On the other hand, there is reference to Tsushima. But its impact, which meant for Russia, not only the loss of a fleet, but the *coup de grâce* to her century-old and moribund position as a naval power, is inadequately pointed. In the contemporary international situation, the Russians partly attributed this catastrophe, and with much justice, to the need to move the fleet half way round the world, and through foreign waters, to reach the Pacific. The author notes that a change then took place in the attitude of the government toward the Northern Sea Route, and, significantly, in the attitude of the then Minister of Transport. "This was the only occasion before 1917 on which strategic motives can be said to have played an active part in the development of the Northern Sea Route" (p. 113). But what an occasion! The realities of naval power, and the realities of Russia, old or new, can be discerned only against a broad chronological canvas. In such a canvas, ever since 1905, we see a continuous effort to rebuild the fleet, and we see a stubbornly recurring interest in the Northern Sea Route. It is only a decade later that we find the *Taymyr* and *Vaygach* beginning their voyages along the Route, for admittedly strategic ends. Four years later, the name of the committee established by Kolchak, unless its nomenclature is meaningless, and however fatuous its ambitions, indicates a primary interest, not in the Kara Sea route, but in the entire Northern Sea Route (p. 17). The survival of a similar priority of interest seems to be reflected in the names of is successors, set up one and eight years later. The book brings no evidence that the development of the Northern Sea Route had been, explicitly or tacitly, deleted from the tasks of the last in the line.

To what extent arctic enthusiasts, probably senior to Shmidt, enjoyed the sympathy of the Politburo in the early 'twenties is a question which an unusually taciturn bureaucracy will probably never answer. By the end of the historical survey, the inference is possible that more than inherited enthusiasms and economic stimuli explain the promptness with which Soviet Moscow turned its attention to the North and to the Northern Sea Route in particular. The author observes that the career of Schmidt may indicate deliberate planning as early as 1929 (pp. 62–3), and it has been argued that this began at least in 1928. The initial preparation of control figures must, clearly, have begun some years prior to even that date. Politically, the formation of the G.U.S.M.P. in 1932 suggests an effort to improve control. Economically, its formation suggests sacrifice, for there may be no other major project undertaken by the Soviet government for which a compelling economic explanation is so hard to find. Against this background, the objective of a normally operating sea route in five years suggests more than ambition, it suggests acceleration, some sense of urgency. Is it therefore prudent to infer that the unusual attachment of the G.U.S.M.P. to the Council of Ministers was no more than an administrative compromise dictated by the fact that it was not subordinated to any commissariat? The author makes the interesting observation that of the three most important ports (Ostrov Diksona, Tiksi, and Bukhta Provideniya) the first and last do not appear to have been built for the export trade. Nor does it appear that these are the most important for trans-shipment of the principal goods coming out of the Subarctic. The West is now painfully aware of the sensitivity of the Soviet borders, because the U.S.S.R. has the power to express that sensitivity. Her truculent sensitivity in the 'twenties was not as obvious, since she lacked that power. Nevertheless, it is intriguing to note that the G.U.S.M.P. was formed only six years after Russia laid formal claim to "her" Arctic and eight years after she had reacted strongly to one contesting claim; only four years after Stalin had inaugurated the first national plan with the warning to his people that they had only ten years to prepare; and at about the very time that Soviet defence policy was beginning to react to the rise of the Nazi Party in Germany. Finally, if it seemed a little strange that a report by the head of one enterprise, the Northern Sea Route, should appear on the agenda of the Eighteenth

Party Congress, it is interesting to note that the same agenda was marked by a number of reports by senior officers of the armed forces. The pace and nature of the efforts to build a through route suggest a deep and abiding defensive interest on the part of the Kremlin. This interest is, after all, merely one more reflection of the typical conservatism of a revolutionary power.

Concern with the motives of the government should not blind us to the motives of the many employees of the G.U.S.M.P. and of the many arctic specialists in the U.S.S.R. There is little doubt that a body of eager workers has been forthcoming, at least in the more responsible, technical grades. Much of this is due to the Russian background, that is, to a national life which is hard, because it must combat an inclement nature. To this ancient need, modern Soviet pyschology has added an impetus in the formal view of man as an active creature, whose consciousness has no meaning except in terms of a struggle with its environment. The twin stimuli of environment and ideology go far to explain the collective response to a program designed to deal with drought in the steppes, with desert in Soviet Central Asia, and with the *osvoyeniye* or conquest of the North. The Soviet system for the formation of public opinion has skilfully exploited these stimuli. Hence the precedence of the political branch in all organizations, and therefore in the G.U.S.M.P. (p. 62). Hence a collective response in which the substitution of the emotional for the rational seems to have taken place to an unusual degree. It is not always clear whether the Centre, which keeps its motives to itself, alone inspires public castigation of deviation on the part of its servants. Were the criticism of Lavrov and the dissolution of the Institute of Economics of the North not merely consistent with a general tendency to wish to get on with the job, and to proscribe the recognition of certain kinds of difficulties? It is not surprising to find instances of apparent victimization by official propaganda (p. 46). Perhaps the stimuli which are employed by the Soviet government, and the native response of the Russians, are more important than the allegedly "scientific" basis of Marxism (p. 88). One questions the statement that because of this basis an extensive scientific program was undertaken in the North (p. 88). Marxism cannot presume to claim the Russian *furor technicus* as its child.

This book has been written with scruplous care and chaste artistry. The selection of statistics has been most judicious, the dangerous drama of the North has been suppressed, and the sources purged of their extravagance. Even those passages which summarize much technical data are a pleasure to read. That the transliterations are so consistent bears witness to the author's special contributions in this field. Minor carping about a half-dozen lapses in proof-reading could not alter the fact that we now possess one mature study of an especially awkward Soviet development.

Space makes it difficult to do justice to the major individual revelations and contributions made by this book. The appendices are particularly valuable, and have clearly called for an effort almost as laborious as that involved in writing the book. It is understood that the author has since found it possible to amplify his important passages on the situation concerning ice forecasting (pp. 95, ff). It is to be hoped that he will similarly find it possible to expand his treatment of Soviet arctic convoy techniques (p. 79). The description of arctic ports and fuel supply will put much flesh on a skeleton of place names. The statute of the G.U.S.M.P. of 1941 was not previously available in English; nor was a definitive bibliography of the materials accessible to scholars in the West. Perhaps most important, the author has demonstrated that recent Soviet silence about the Northern Sea Route does not indicate that this much touted project has been quietly abandoned, or its scale reduced. His data on the performance of Liberty ships suggest that many of the limitations in the use of the Route thus far apparent can be largely attributed to the lack of greater virility in the Soviet economic potential.

The maps on pp. 80 and 107 should show the Kotlas-Vorkuta Railway as reaching the west bank of the Ob' at Labytnangi, just west of Salekhard. Recent Soviet maps, and they are probably to be believed, have thus clarified the question of a terminus once mooted at Khabarovo which is mentioned on p. 83. Such an extension argues possibly greater use of the Ob' than has been implied on pp. 65 and 108. On the other hand, the latest maps no longer show the projected route of the Baykal-Amur Trunk Line, which is given on p. 107. It now seems doubtful that this project will be completed, as long as Japan, or some other Oriental power, does not rise to threaten the borders of the Soviet Far East. It is not clear that Mangazeya is only a site, and that if any settlement now exists there, it is not so called (p. 2). On p. 80, the placing of Turukhansk is somewhat ambiguous. One would welcome documentation for the estimate of the territory controlled by the G.U.S.M.P. after 1938 (p. 56). It is scarcely fair to describe the *Sovnarkom* (now the Council of Ministers) as the equivalent of our Cabinet (p. 37), for it appears to lack the real power of policy. A footnote to explain the usages "Murman" (p. 33) and "Chukotka" (p. 23) would have been helpful, even for readers who command Russian. There would seem to be little point in restricting the definition of the Northern Sea Route to the waters between the Barents Sea and the Pacific (p. xii). It does not appear that the Russians so think of the Route; and, in that it would make no difference either to the substance of the study or to the presentation thereof, there is perhaps some merit in adhering to the Russian concept, vague as it is. This is, apparently, all the coastal waters lying between Murmansk and the Pacific, and therefore includes the Barents Sea.

Virtually all the evidence pertaining to the Northern Sea Route has been assembled in this book. The interpretations placed on this which differ from those of Mr. Armstrong require little which he has not brought to the reader. To the extent that other interpretations are possible, we are really faced with an instance of the difficulty as to how much of Russia must be examined for the appreciation of one development. To a degree perhaps unique among societies, the U.S.S.R. seems to challenge the contemplation of any of its institutions in isolation; it seems to query the adequacy of the use by a foreign observer of only one discipline; and it seems to encourage the integration of conventionally disparate streams of evidence. The latter seems to be the only wedge capable of penetrating the extraordinarily oblique grain of Soviet public expression. C. J. WEBSTER

REVIEWS

ALASKAN ADVENTURE

By Jay P. Williams. *Harrisburg, Penn.: The Stackpole Company, 1952. 9 x 6 inches; xiii + 299 pages; illustrations, diagrams, and end-paper sketch-maps. $4.50.*

I know something of the country about which Jay Williams writes. I have been learning about it for more than twenty years, which is just about as long as I have known and admired Jay. His is a remarkable book. Many of us who are more or less familiar with southeastern Alaska, or the Prince William Sound country, or the Alaska Peninsula, have long accepted Jay as an authority on the country and its wildlife. Few of us, I suspect, have recognized his ability to set down in writing in simple, matter-of-fact, but somehow extraordinarily effective prose, his observations, knowledge, advice, and, above all, his feeling for the country and his appreciation of the subtle relationships between wild animals and their environment.

The book is a treasure-house of information about outdoors Alaska, especially about the larger game animals. The chapter on the Rocky Mountain goat (Chapter 3) impresses me as one of the best treatises on any game animal that I have read and certainly by far the best description of the goat and its habits.

The book is full of bear lore. Although I am in no sense a zoologist, I was not only amused by Jay's good-natured ribbing of the zoologists' practice of classifying Alaskan bears into many species, but I was also infected with the feeling that Jay knows what he is talking about. The last paragraph starting on page 97 and continuing on page 98 seems a classic of gentle irony in this respect, especially the sentence: "It had been duly determined in scientific conclave assembled, that his premolar on the right side was slightly longer and less eroded than his brother's, hence a new clan was born with himself as the founder."

Jay does seem a little rough on the bald eagle but, after all, he has observed a great many eagles at all seasons of the year and his opinion must be accorded very substantial respect.

The illustrations are the one disappointing feature of the book. Many of them appear to have been good photographs, but their reproduction is very poor and they do not do justice either to the country or to the game animals shown.

John C. Reed

OOK-PIK: the story of an Eskimo boy.

By William G. Crisp, with drawings by Jean Crisp. *Toronto: J. M. Dent, 1952. 8¾ x 6½ inches; viii + 151 pages; drawings. $3.00.*

'Ook-Pik' describes a year in the life of an Eskimo boy at that exciting time when he is just becoming a man. For Ook-Pik it was an exceptionally full year. It begins in the fall when he makes his first sledge and trains his team of three young dogs. The winter is spent in learning to hunt on the sea ice, and in the spring he accompanies a constable of the R.C.M.P. on a long patrol by dog team to a post in the west. He is there for ship-time and then returns home by aircraft.

It is, of course, a child's book, but it is a faithful and sensitive account of the Copper Eskimo, and any child more than six years old should enjoy it. There is no upper limit to the age group. This is the sort of book that performs a real service to Canada. It promotes interest in a region that is daily becoming more important to the country but is frequently neglected in the schools, it provides authentic information, and it should give the young a better understanding of the Eskimo than their parents possess. I hope it has the success it deserves and that it is only the first of a series of similar books by Mr. Crisp who understands the north, and knows how to write about it.

G. W. Rowley

NORTH POLE BOARDING HOUSE

As told by Elsie Gillis to Eugenie Myles. *Toronto: Ryerson Press, 1951. 8½ x 5½ inches; viii + 206 pages; illustrations. $3.95.*

In the summer of 1945 Mrs. John Gillis and her husband sailed in the R.M.S. *Nascopie* to Arctic Bay where a meteorological station had been established during the war. Mr. Gillis was one of the meteorological staff of four, and his wife was employed as cook for the station. 'North Pole Boarding House' is an account of her experiences, written in collaboration with Mrs. Ernest Myles, during her year's stay in the north. At a time when so many arctic narratives are more fiction than fact, it is refreshing to read such a straightforward account. Mrs. Gillis describes her daily life throughout the year and faithfully records the activities at the station. She was fortunate in seeing a good deal of such well-known characters in the Eastern Arctic as Canon Jack Turner and his wife, Father Cochard, and Jimmy Bell. It was an uneventful year and it is greatly to the credit of Mrs. Gillis and her collaborator that the reader's interest is held throughout the book. The temptation to exaggerate and embellish has been firmly resisted, and there are remarkably few errors, none of them important. G. W. Rowley

GRØNLANDS FUGLE: THE BIRDS OF GREENLAND: PART III

By Finn Salomonsen, with illustrations by Gitz-Johansen. *Copenhagen: Ejnar Munksgaard, 1951. With parallel texts in Danish and English. 13 x 9 inches; pp. 349–608; 16 coloured plates, and line drawings. Complete set, Parts I–III, $42.00.*

This is the third and final volume of Salomonsen's great contribution to arctic ornithology. Biographical accounts are given of twenty-two forms: the auks, birds of prey, and passerine birds. These accounts are full and informative and are of value not only to the ornithologist but to those interested in the economy of the native people.

There is a section devoted to a systematic list of the 224 kinds of birds that have been known to occur on the island; a particularly useful inclusion owing to the many footnotes in which Salomonsen evaluates controversial records.

The bibliography, covering 18 pages and including some 600 titles, and an adequate index of Latin, Danish, English, and Eskimo bird names, complete the text. There is included with this volume a map of Greenland (folded, 23 x 16 inches). This has been prepared especially for the work by the author and the Danish Geodetic Institute.

T. M. Shortt

INSTITUTE NEWS

Election of Dr. A. L. Washburn as Honorary Member

At the Annual Meeting of the Board of Governors on 8 November 1952 Dr. A. L. Washburn was elected an Honorary Member of the Arctic Institute. Dr. Washburn is thus the fifth Honorary Member to be elected since the start of the Institute. The other Honorary Members are: Admiral R. E. Byrd; the late Lincoln Ellsworth; Dr. J. B. Tyrrell; and James M. Wordie.

Annual Meeting of the Board of Governors

The Annual Meeting of the Board of Governors was held at the Institute Headquarters in Montreal on 8 November 1952. The following members and officers were elected for 1953:

Officers of the Board: Chairman, Rear Admiral E. H. Smith; Vice-Chairman, A. E. Porsild; Secretary, Graham W. Rowley; Treasurer, Walter A. Wood.

Governors elected by the Fellows of the Institute: Prof. Richard Foster Flint (Board member 1945–50, Chairman 1950), Yale University; Dr. Hugh M. Raup, Harvard University; Graham W. Rowley (Board member 1950–2), Defence Research Board of Canada.

Governors appointed by the Board: Robert F. Legget, National Research Council of Canada; Rear Admiral E. H. Smith (Board member 1950–2, Vice-Chairman 1952), Woods Hole Oceanographic Institute; R. E. Stavert (Board member 1950–2), Consolidated Mining and Smelting Company, Montreal.

Retiring Governors: Dr. C. H. D. Clarke; Governor E. Gruening; Comdr. Finn Ronne.

Baffin Island—1953 plans

Plans are being made at the Montreal Office of the Institute for another expedition to Baffin Island. A party of about twelve men will investigate the meteorology, glaciology, geology, botany, and zoology of the Cumberland Peninsula area between Pangnirtung and Padloping.

The glaciological program will be a continuation of the work done in 1950 on the Barnes Icecap, 300 miles to the northwest. This icecap lies at a maximum elevation of 3,700 feet above sea level. The Penny Highland icecap which will be examined in 1953 is much higher (between 7,000 and 8,000 feet) and is expected to show different characteristics. The party will also study one of its outflowing valley glaciers which leads down to Pangnirtung Pass.

This pass is one of the most spectacular in the Eastern Arctic with mountains up to about 8,000 feet rising above it. The geology and geomorphology of the pass area will be closely examined and, as in 1950, a group from Switzerland will be included to do work on the high peaks. Biological activities will be concentrated also in this region and in the fiords at each end of the pass.

The expedition expects to leave by air in May, to be fully established on the ground by early June, and to return by sea in September. Heavy stores are already at Pangnirtung. Most of the personnel are selected and will include at least three members of the 1950 party: P. D. Baird (leader), S. Orvig (meteorologist), and W. H. Ward (glaciologist). W. R. B. Battle (glaciologist), the Senior Carnegie Fellow of the McGill University-Arctic Institute research program, will be a member, and perhaps three other students from this university.

Gifts to the Institute

The Chairman and Board of Governors most gratefully acknowledge the following gifts:

Donations from Corporations

Aluminum Company of Canada; Canadian Industries Ltd.; Consolidated Mining and Smelting Company of Canada Ltd.; Imperial Oil Ltd.; Rockefeller Brothers Fund; The Southam Company; and Ventures Ltd.

Donations from individuals

John C. Case; William O. Field, Jr.; M. H. W. Ritchie; W. Taylor-Bailey; A. L. Washburn; and Walter A. Wood.

Gifts to the Library and Museum

Canadian-Scandinavian Foundation—donation for purchase of Scandinavian books and periodicals.

L. A. Learmonth—Coronation Gulf Eskimo material.

Haven A. Requa—portrait of Sir John Ross.

James V. Stowell—photographs of Peary records.

Increase in Associate Membership dues

The Institute much regrets that it has been found necessary to raise the annual dues for Associate members from \$3.00 to \$5.00, as from 1 January 1953. Registered students under the age of 25 years may subscribe at the former rate.

ELECTIONS OF FELLOWS

At the Annual Meeting of the Board of Governors on 8 November 1952 Admiral L. O. Colbert, Arctic Institute of North America, Washington, was elected a Fellow of the Institute.

INDEX